THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXII. No. 1585.] LONDON, SEPTEMBER 26, 1893. [45TH YEAR. PRICE 6d.

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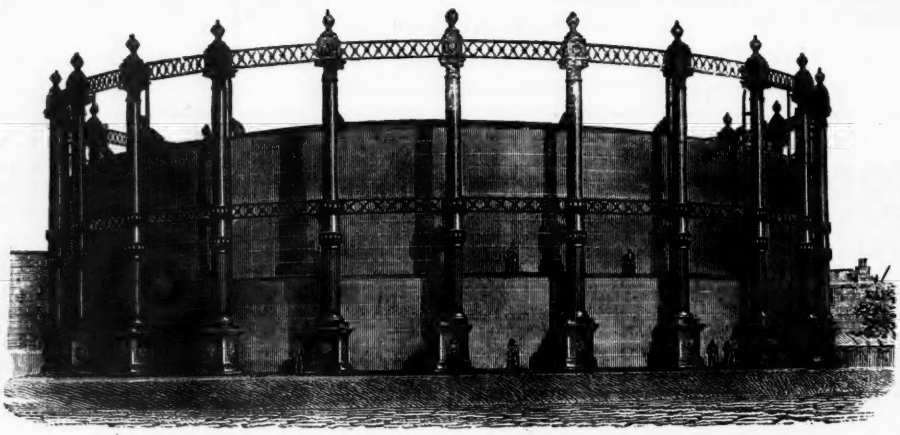

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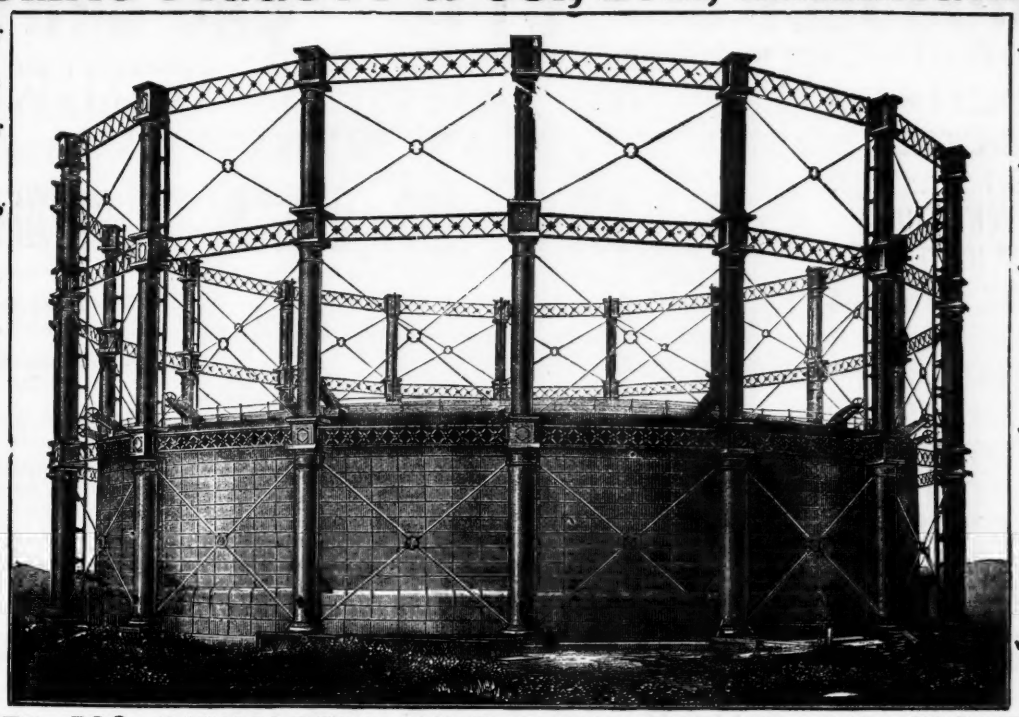

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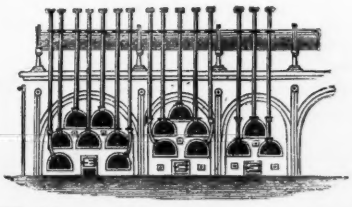

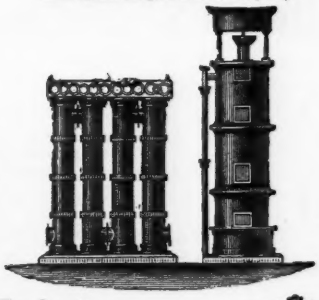

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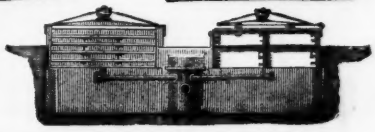

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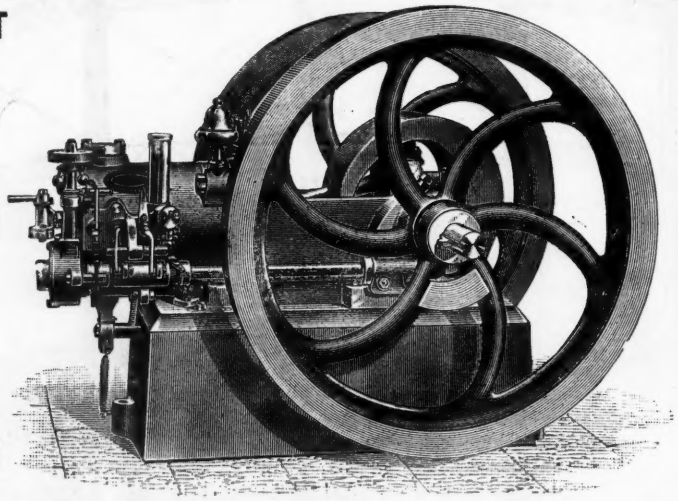

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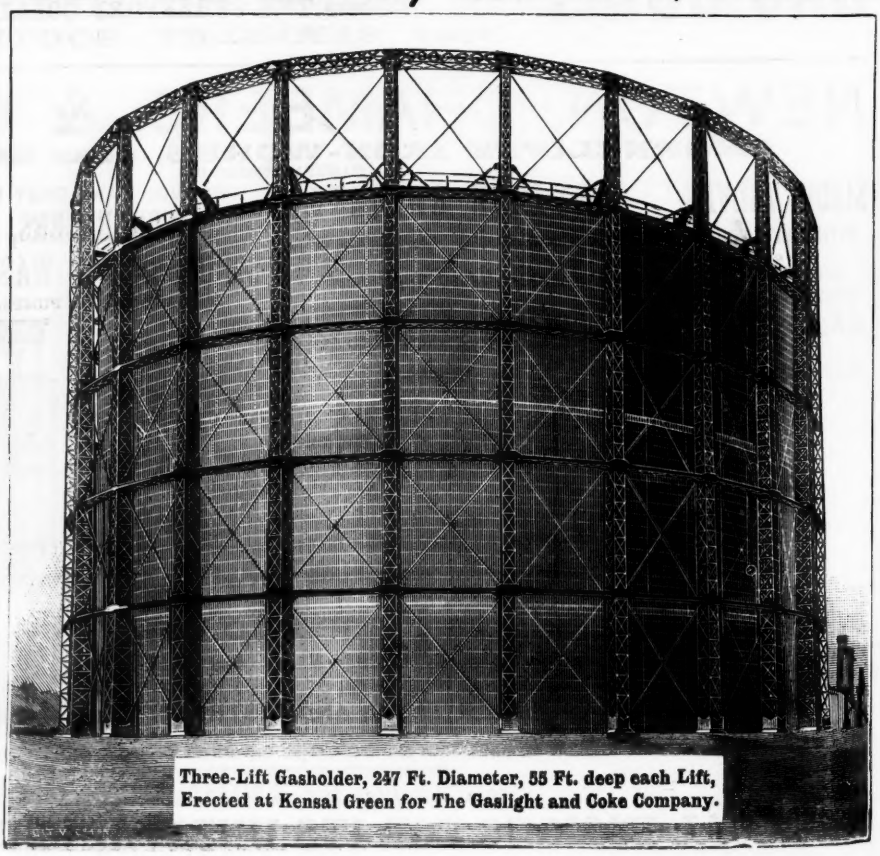

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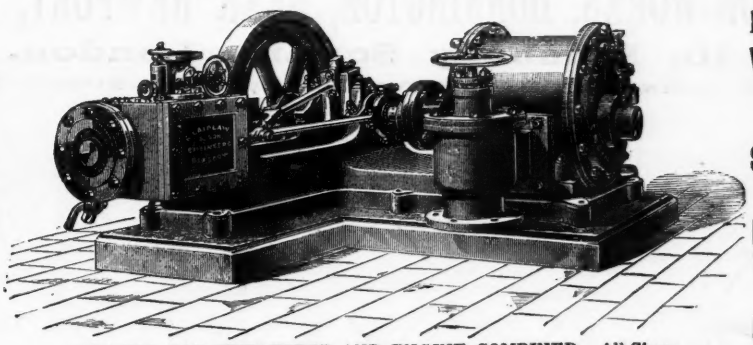

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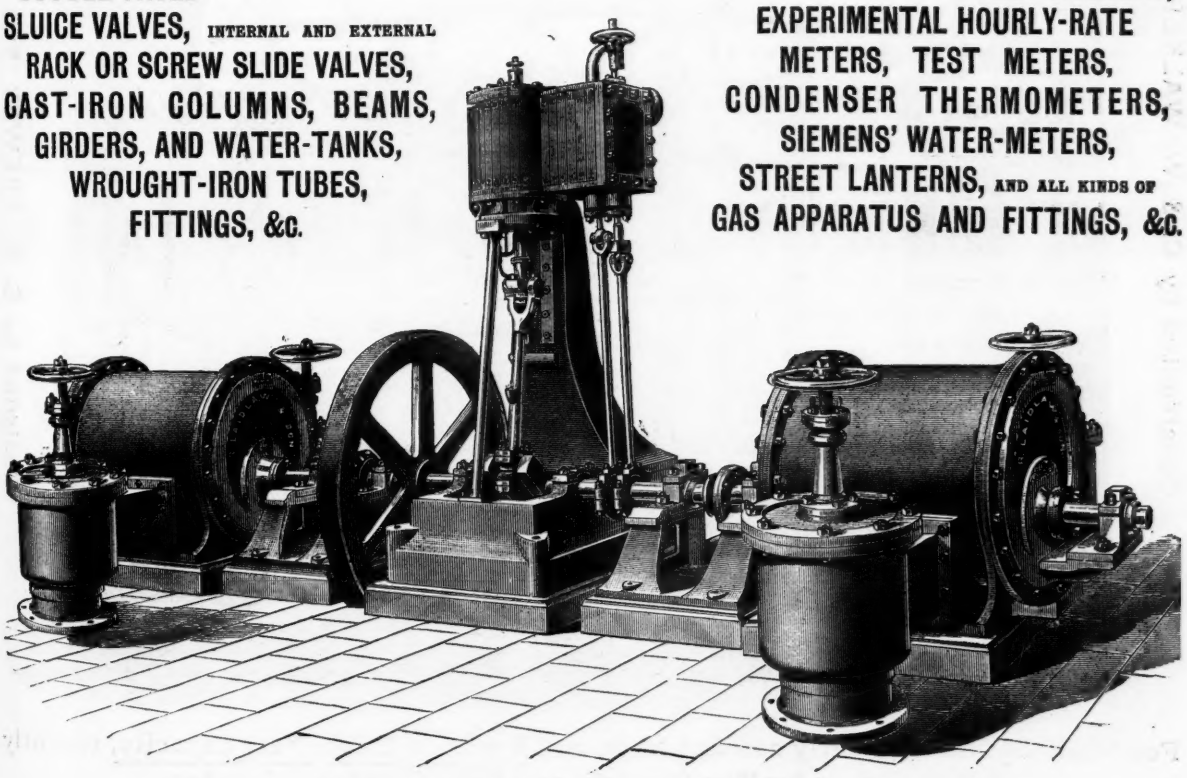

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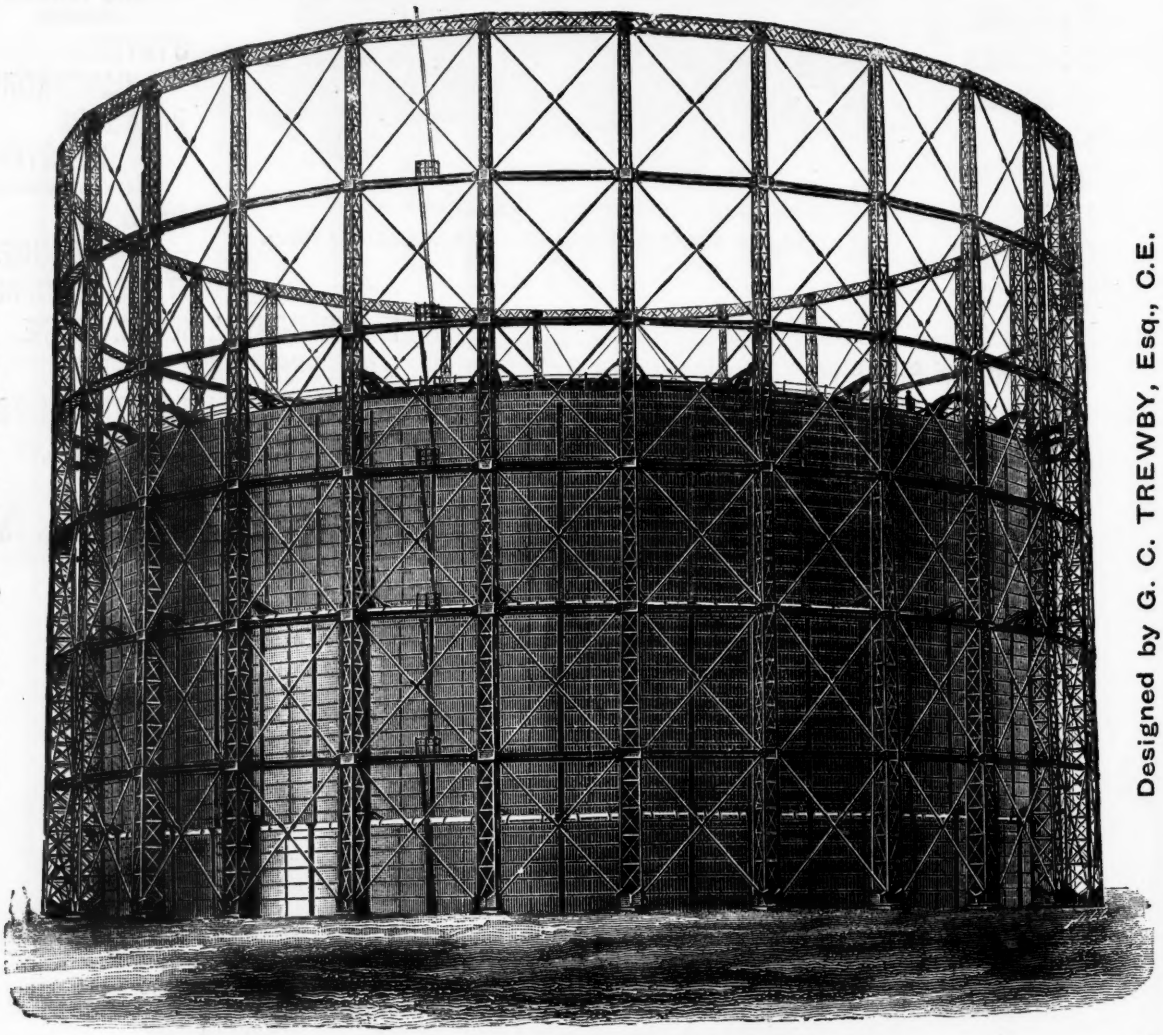

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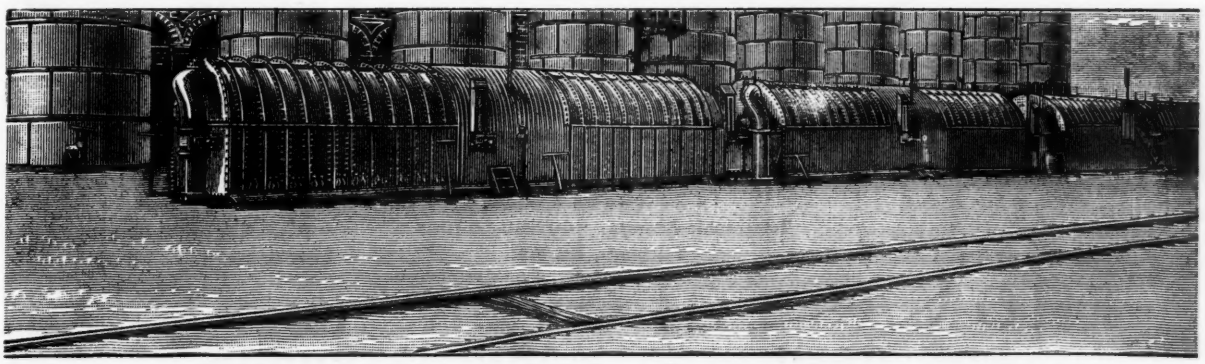

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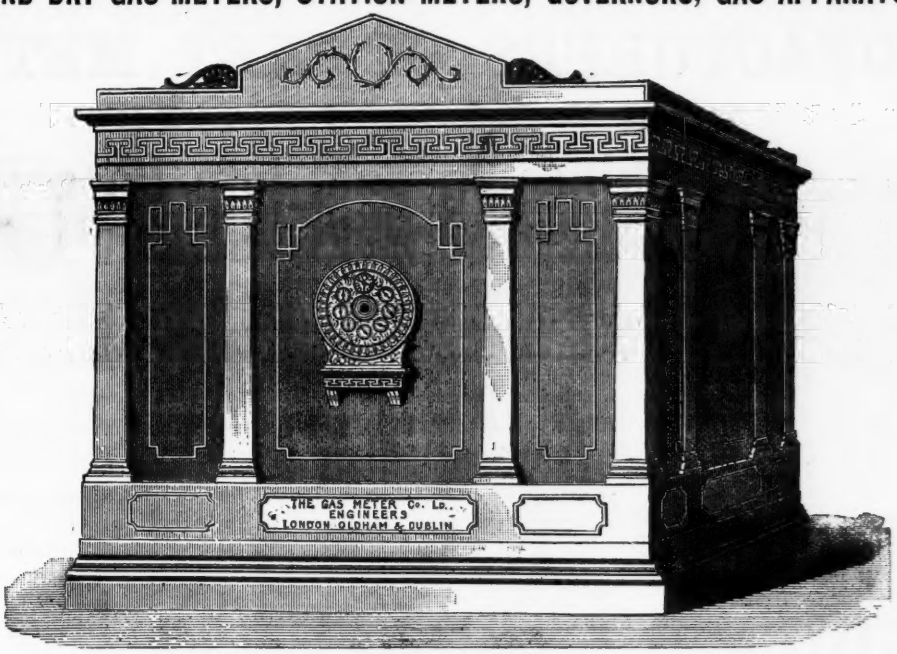

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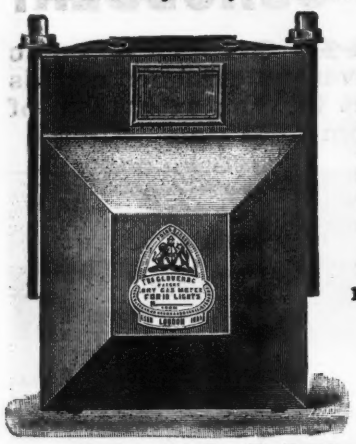

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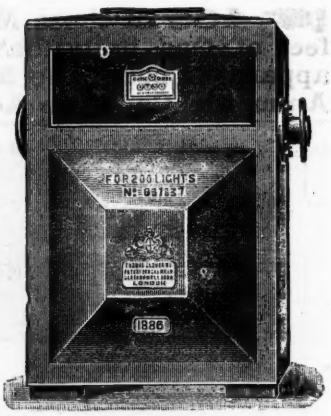

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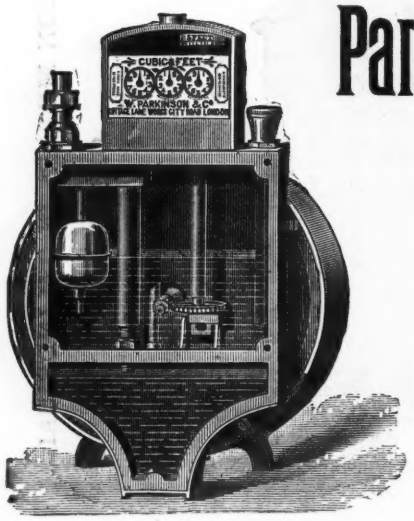

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TUESDAY, SEPTEMBER 26, 1893.

The Proposed Coal Trust.

THE scheme for a National Coal Trust, which has been put forward under the auspices of some leading men in the trade, with Sir George Elliot at their head, has attracted some little attention during the week in several newspapers; but nothing like a sufficient discussion of its details has yet been attempted—possibly because the general public are still waiting like ourselves for further particulars. The first authoritative criticism of the idea has been contained in a letter from Mr. George Livesey to *The Times;* and even the Chairman of the South Metropolitan Gas Company writes with conspicuous reserve on the subject. This is only natural, because, as a matter of fact, the abstract of the scheme which we give in another column was taken from that paper, and remains so far the only disclosure of the heads of the project. The text has not yet been published anywhere. Mr. Livesey declares that he approaches the question in no unfriendly spirit towards those who are dealing in this way with the unsatisfactory condition of the coal trade. It is indeed high time that the matter was taken in hand with a single view to the discovery of an acceptable solution of the difficulties that embarrass the trade; and in this task all parties concerned—coalowners, miners, and consumers—ought to join their forces, for it is perfectly certain that none of them will succeed in arriving at a solution unaided. It is hardly necessary for us now to make a fresh profession of our belief that syndicating certain trades is a perfectly legitimate way of preventing the evils of mutually destructive competition. The actual condition of the gas business of the United Kingdom is a sufficient warrant for the opinion that there are some industries in which regulation, in the interest of all parties concerned, is to be preferred to ordinary commercial competition; and the only questions to discuss, when any extension of the system is proposed, are whether the subject is suitable, and whether the means suggested are expedient. The coal industry is one which seems, on the face of it, particularly amenable to organization. We confess to sharing the theory that the coal capital of the country is in the highest sense a national possession, and that its expenditure ought to be conducted in such a way as to be fairly beneficial to the trade and the community. If the commercial methods hitherto brought to bear upon coal getting and marketing had worked satisfactorily, there would really be no more to be said. The facts are, however, notoriously otherwise; and now it is but rational that people should begin to ask whether some better arrangement cannot be devised. The chief objects to be set before any scheme of reorganization of the coal trade which might be described as deserving of public sanction are thus defined by Mr. Livesey: "(1) To conserve the nation's stores of coal, and "to ensure the getting of them in the most economical "manner and with a minimum of waste. (2) To secure "fair remuneration for coalowners and miners, and "to promote such mutually satisfactory arrangements "between them as will prevent trade disputes; and, "further, to make it their joint interest to do their "best for the public. (3) To enable the public to "obtain their coal at the lowest possible price; and "to protect them from such disastrous fluctuations "of price as those of the panics of 1872-73 and 1889-90." We desire to say only one word more upon this subject for the present; and it is that it will facilitate the acceptation of any scheme by the representatives of the miners if it is made clear to the latter that positions may be found for them in connection with the new organization. One more attempt may well be made to enlist the force of Trade Unionism in a work of construction.

The Adjournment of Parliament.

PARLIAMENT has at length adjourned, to meet again in November, when an attempt is to be made to produce something by way of addition to the statute-book, to redeem the session from the reproach of barrenness. With the political aspect of the parliamentary situation we are, of course, not concerned; and the Private Bill business done during the past few months is not of a character that calls for more comment than such parts of it as are directly interesting to our readers have already received. We are concerned, however, in common with the rest of the community, in the aspect presented by the present Parliament as a machine for transacting the ordinary legislative work of the country. This cannot be regarded as at all satisfactory. We suppose the conditions may be described as abnormal. It is not often that a House of Commons is so nearly divided between two parties as to make the forces of action and reaction in a particular direction practically balance each other; and observation of the doings in the House during the past session does not warrant anybody in hoping that this state of parties may be frequently realized. Not only has the House been prevented by this peculiarity of its composition from acting effectively in political matters upon the lines favoured by the majority, but progress with less contentious matters has been sadly hindered. The experience of the London County Council illustrates this view; and the troubles of this municipal organization, in endeavouring to get its Bills through, are shared by other public bodies. Take the single matter of Betterment, for instance. It is very easy to show that this question is no nearer settlement than it was at this time last year. The lesson

that may be drawn by municipal authorities generally, from the disappointment of the London County Council in this regard, is that it is not of the slightest use to go to Parliament with any project for modifying existing law and practice, unless all the loose ends have been carefully tied up beforehand. The House of Commons has no time to thresh out such schemes; and the House of Lords, which has the time, will not act unless the advantages of altering the *status quo* are placed beyond dispute. It is idle to abuse the Upper House for adopting this policy, which is, after all, only that of second legislative chambers in every country. The question of Betterment lies next door to that of the Unearned Increment; and nobody has yet ventured to treat either in a Public Bill, so as to make an alteration of the laws of property and rating which shall be of general applicability. Such a solution of the problem is confessedly not to be hoped for. The most that the advocates of taxing Betterment or securing the Unearned Increment, in the case of real estate, for the public benefit, can propound is a scheme for particular application. This will not do; there are too many loose ends hanging from any special scheme of the kind for objectors to lay hold of. So we say to all and sundry who may have private business to push through Parliament, that they must see to it that they do not appear by their programme to snatch a precedent in regard to any open question; if they do, they will lose their labour and their money.

The Coal Trade Crisis.

THE most important feature of last week's contribution towards the development of the coal question was the meeting of the associated coalowners at the Westminster Palace Hotel on Thursday. For some days before, the newspapers which favour the men contained statements respecting the resumption of work at certain collieries where the old rate of wages was to be had; and it had become clear that the strike leaders were convinced of the necessity of yielding with a good grace a point that certain of their supporters were determined to carry with or without their consent. Only a week earlier, the proposal of partial resumption of work in Staffordshire and Warwickshire and the Nottingham district was rejected at the dictation of Messrs. Pickard, Woods, and other heads of the Federation. But the giving out of the strike funds proved to be too strong an argument for the officials to combat; and accordingly Mr. Pickard, with an agility of mind that showed the effect of his parliamentary experience, posed as adviser of the course he had just condemned, leaving Mr. Woods and some of the clumsier-witted wire-pullers far behind. Naturally, the *Daily Chronicle* applauds the strategic movement; naively confessing that "it simply "will not do to allow Durham and Wales to cut out the "Federation." Seeing that Durham and Wales have from the first declined to dance to the Federation tune, this discovery on the part of our popularity-hunting contemporary is rather belated. Of course, it is argued that in returning to work—subject to whatever settlement may be eventually arrived at respecting the rates of wages in the Federation district—the men who take this step are not acting against the Federation. To put the point this way would be absurd, according to the artless argument of the *Daily Chronicle*, which is apparently prepared to call black white at the instigation of Mr. Pickard. All the same, it is a step that the Federation scouted as treasonable not many days ago. In the circumstances, with lawlessness checked by a strong hand, an exhausted strike fund, and the strikers weakening in several districts, much curiosity was aroused respecting the result of the masters' meeting on Thursday. It transpired that the Federation Executive had approached the Secretary of the Owners' Association with a cool proposal to resume work on the old terms. They admitted that they had advised the members of the Unions to "stand firm" against the proposed reduction; and observed that they were "prepared "to meet the owners to discuss, in the interests of the "trade, the necessity of their demand being withdrawn." The Associated Coalowners did the Federation the honour of meeting to consider this modest suggestion for completely stultifying themselves by admitting that the lock-out was uncalled for; but they unequivocally declined to "encourage false hopes by accepting a meeting on such "a basis." This statement of the coalowners is only of a piece with their action all through the strike; but it is significant that the rumours of divided counsels which the Union leaders have been disseminating for the solace of their victims have no foundation in fact. Once more the masters profess their readiness to meet the miners' representatives "to discuss the proposed reduction"—a very different thing from meeting to discuss how the proposal may be withdrawn. Of course, the miners' leaders are trying to throw upon the masters the blame for all the trouble caused by the strike; and their press friends implore the coalowners to "come to the conclusion "that they have pressed their claim far enough"—when, so far, nothing has been agreed upon! We admit that the situation is very grave; but there is no sign that the coalowners entered upon this struggle with light hearts, or that, having formulated their claims, they will abandon them merely because the other party are resisting them at vast cost and suffering. The employers would deserve all that their bitterest enemies say against them, and more, if before making their demand they were not prepared to adhere to it throughout all the clamour their action was certain to arouse. Nothing has happened to alter the basis upon which the employers made their offer to the miners; and for them to give way now would be to admit that the whole thing has been a "try on" of a peculiarly wicked kind. Meanwhile, the increasing sadness of the situation will bespeak particular attention for the scheme of consolidating the coal trade referred to in another column. It may possibly happen that the breaking of the power of the Federation will turn out to be a prelude to the reorganization of the coal-mining industry upon a system that shall secure a "living wage" to everybody concerned.

The Language of the Gas Industry.

IT is not a little to the credit of the members of the gas engineering profession in the United Kingdom that they rank high among technicians in the matter of maintaining their language pure and in a condition to be "under-"standed of the people." It is unhappily only too notorious that the custom of talking about technical subjects as between followers of the same profession is apt to lead speakers and writers into the use of slang terms, and expressions that may be described as "short language," which if indulged in infallibly results in degrading the language, and removing it from general comprehension. Imperfect education to start with is the chief predisposing cause of this error; for it is always found that those specialists who are best cultured as scholars, philosophers, and men of the world, manage to talk and write of the most recondite technical matters in the most intelligible way. Persons of indifferent culture seem to think it a fine thing to talk and write in jargon; and consequently many of the lower orders of specialists of the present day, whether they scribble in cheap newspapers or air their "notions" in technical publications, indulge in so many catch phrases and shoppy allusions as to give their readers, even when they understand them, the impression that such writers have no ideas beyond their immediate occupations. Thus the would-be "smart" reporter of a halfpenny evening newspaper takes a mistaken pride in impregnating his paragraphs with the smell of "flimsy" and printers' ink, and lets the pencil stick out in every sentence. Only too often the engineer betrays his affinity with the illiterate mechanic by employing the limited vocabulary of the latter. The other day an engineering journal that ought to have known better published some illustrations of water-tube boiler settings in which the specific name of a particular make of boiler was turned into a substantive title. It was "View of a Babcock Fired with Liquid "Fuel," and so on. This is the way to the abomination of desolation in technical writing; and we protest and warn our readers against it with all the energy at our command. As already stated, however, British gas engineers are creditably free from this vice; and everything that we can do to discourage it shall be done. The troublesome circumlocution by which the price of gas in this country is given as so much "per 1000 cubic feet" has been lamented in these columns. But the fact cannot be altered; and it is better to repeat the numerous words and syllables of our unit of commercial measurement in full than to create confusion by attempts to express it in imperfect short phraseology. In one conspicuous example, the technical language of the gas engineer is more correct than popular talk—it no longer contains the word "gasometer," which still commonly appears in non-technical writing,

According to some dictionaries, however, this old-fashioned term is rightly applied to gasholders which are also used as gas measurers, in the absence of a station meter. Throughout the nomenclature of gas-works and gas distribution, there may be traced a praiseworthy appropriateness; and English gas engineers do not attempt to save trouble by calling a particular kind of retort-lid a "Morton." If, in the intimacy of fraternal conference, they allow themselves to call an inclined retort a "sloper," the levity goes no further, and, being of the nature of a private and confidential remark, is never alluded to in print. To sum up the matter, it must be held that the vulgar trick of employing technical slang, which is sometimes practised with a view to showing extreme familiarity with the matters referred to, is to be carefully guarded against by every engineer who desires to rank as a gentleman and a master of his profession. It does not render the user's meaning clear, but, on the contrary, obscures it; for the slang that passes current in one district or at one period is unintelligible in other places and at a different time. A slangy technician, in his endeavours to be ultra-practical, only succeeds in resembling the German philosopher of whom it was said: "Unless "you know what he is talking about, it is impossible to "tell what he says." It is paradoxical, but true, that the ultimate triumph of English scholarship is the ability to write plain English. This is a gift that comes by nature to some, but more have to acquire it at a great price. Happily, there is nothing in the pursuit of gas engineering inimical to the cultivation of this crowning grace; and the literature of the industry contains as good specimens of English composition as can be found in the technical writings of any other science or art.

British Association Lectures.

In another column will be found reports of the lectures delivered by Professor Vivian B. Lewes and Professor Smithells in connection with the Nottingham meeting of the British Association. It is like repeating an old story to say that Professor Lewes carried his audience away with him, and scored a personal triumph at Nottingham, but it is the truth; for, as all who have had the pleasure of "sitting under" the Chief Gas Examiner to the Corporation of London know, the instruction conveyed in this lecturer's matter is almost subordinated to the fascination of his manner. It is a compliment which might be regarded as flattering by any scientific man, to be appointed to give "the lecture to working men" at a British Association meeting. It is a performance that has been associated with the names of the foremost leaders of science in Britain; and the institution of the lecture is to be regarded as a means of bringing to the people a sense of the indebtedness of the world at large to modern science, which has done so much to ameliorate the common lot of humanity. Professor Lewes will, we are quite sure, desire no higher praise than the acknowledgment that he has worthily maintained the reputation of the "lecture to working men" in this regard. Professor Smithells is favourably known as an enthusiastic worker upon the phenomena of flames; and his name is connected with an extremely pretty experiment in which an atmospheric flame is dissected in such a way as to enable its interior to be explored more perfectly than was ever done before. We understand Professor Smithells to argue that the nature of an atmospheric flame is identical with that of a luminous flame—an opinion that is not considered tenable by some other observers. The fact is that the nature of flames has not yet been thoroughly worked out; and the circumstance mentioned by Professor Smithells, that perhaps Dr. E. Frankland has not yet said his last word on the subject, corroborates the suspicion that more than one last word remains to be heard about it. We notice that Professor Smithells, in the latter part of his discourse, apostrophizes oxygen as "the "element which has ruled the earth's chemistry through-"out all geological times and long precedent ages of its "evolution." This is undoubtedly true to a very large extent; but if Dr. T. L. Phipson's conception of oxygen, as being a comparatively late addition to the earth's atmosphere, is correct, the remarks of Professor Smithells must be taken with an amount of limitation that is nowhere suggested in the text. To put it briefly, there is a good deal of confusion just now respecting the fundamental data of cosmogony.

WATER AND SANITARY AFFAIRS.

The full report of the Royal Commission appointed to inquire into the Water Supply of the Metropolis was issued as a Blue-book on Friday last. We had previously commented on the conclusions arrived at by the Commissioners; these being sufficient to remove all doubt as to the excellency of the supply, and the adequate character of the existing resources. While the quality of the water was highly commended, it was shown that, by a perfectly practicable enlargement of the present works, any probable increase in the population of Greater London and contiguous parts during the next half century would be amply provided for. Satisfactory as all this must be to the inhabitants of London generally, such a declaration cannot fail to be highly exasperating to the "Progressives" of the London County Council. On Tuesday next the authorities at Spring Gardens will reassemble after their prolonged holiday; and the storm may then be expected to burst. Some mutterings of the coming thunder are already to be heard. The *Daily Chronicle* complains that the effect of the report will be to "enormously strengthen "the position of the Companies." But that position will not be made any stronger than it ought to be. Justice should assuredly be done, even to the London Water Companies, although, as a consequence, the prospect of their property being "taken over" by the County Council is, in the opinion of the *Chronicle*, now rendered "somewhat gloomy." That is to say, "taken over" after the manner of an "old iron" valuation. If the Council want the undertakings, and can show that the public will be best served by such a transfer, they can get possession by paying a fair price, or by making some equitable arrangement. This, however, is not the policy espoused by the *Chronicle*—an organ which urges the people of London to "speak out if they wish to secure for themselves and for "their posterity a pure water supply." That is to say, the people so appealed to must be prepared to spend a few millions for the sole purpose of furthering certain views entertained by the County Council; those views being in direct opposition to the recommendations of the Royal Commissioners. There is the usual cry about being delivered from "the bondage of the water monopo-"lists." But "the people of London" will very likely conclude that, if they wish to escape bondage in respect to the terms and conditions of the water supply, the less the County Council have to do with the matter the better. *The Times*, in a leading article of considerable length, deals favourably with the conclusions arrived at by the Commissioners, and remarks that the report, taken as a whole, amounts to a declaration "that the existing Water Com-"panies, which are doing their work well, need not be "superseded by any Trust or Committee, derived either "from the County Council or from the Corporation." *The Times* also entertains the idea that the discussion arising out of the report will "leave its main propositions "unshaken."

The report now before us is an extensive document, and invites very careful reading. The Water Committee of the County Council wished the Royal Commissioners, in estimating the sufficiency of the supply, to look forward for at least fifty years. But the Commissioners say in their report: "We believe that forty years forms the "longest prospective period that it is usual to consider in "questions of water supply;" and it appears that some members of the Commission were even inclined to think forty years too long. This period, we may here observe, takes its start from the date of the last Census.. The area chosen is also a very important consideration. The Administrative County of London comprises 121 square miles. "Greater London" extends over 701 square miles; and it is in the zone, or "Outer Ring" which lies between these two areas that population is most rapidly increasing. The area termed "Water London," over which the eight Metropolitan Water Companies collectively have parliamentary powers, includes all the Administrative County and part of the Outer Ring, but extends in certain directions beyond the limits of Greater London; the entire area so comprised being about 620 square miles. After due consideration, the Commissioners did not think it would be satisfactory to take any smaller area as the basis of their inquiry than the 701 square miles of Greater London. To this they ultimately added certain parts of Water London which lie outside that area,

The population of this extensive region is that to which the Commissioners refer in their conclusions, when they speak of a daily supply of 420 million gallons, equal to 35 gallons per head. This, moreover, is equivalent to a population of some 12 millions—a number which is about three quarters of a million more than the population to be provided for in 1931. *The Times* reckons that this will carry things on to 1940, or practically fifty years from the date of the last Census. The further supply, which the Commissioners believe can be obtained from the chalk area lying eastward of the Kent Company's district, renders the result so much the surer. Figures such as these show how great is the problem of administration which has to be considered. Supposing the water supply, as sketched out by the Royal Commissioners, to become the property of the London County Council, the authority of that body must, in respect to such supply, extend over an area immensely larger than that which constitutes the Administrative County. It is very well to talk about supplying water in bulk to outlying districts. Such an arrangement might or might not come to pass. The present system works smoothly and efficiently. It can be extended as occasion may require; and the prospect is an assured one. Should the supply be transferred to the County Council, and the eight Companies removed from the scene, a cumbrous mass of machinery would have to be created, for the proper working of which there would be no guarantee.

The County Council are now in a curious and well-deserved dilemma. They have condemned the water supply which the Royal Commissioners have approved. How can the Council seek possession of a supply which they have declared to be perilous to the health of London, and also derived from sources which must speedily fail? Will they accept the judgment of the Royal Commissioners as superior to their own, and ask to be entrusted with the task which the Commissioners have sketched out as the future work of the Water Companies? Or will they, on the other hand, contest the report, and declare it to be all wrong, after the manner of Mr. A. C. Morton, M.P., who denounces the recent inquiry as "a sham and a "fraud"? They may do any one of these things; and, of course, the way is open to them to ask for a further inquiry —not as to what the supply is or may be, but as to the right parties to possess it. After all, this is the consideration most dear to the County Council, and the only one which the Commissioners were not called upon to deal with. The Council are clearly defeated on the questions of quantity and quality in respect to the water supply. The testimony on the latter point, as quoted by us last week, is most emphatic. In the full text of the report, we find the Commissioners referring to the evidence of Dr. Frankland, who they say has been well known as "no "sparing critic of the London water;" and the evidence of this witness is cited as showing that the raw water of the Thames and the Lea, as treated by the Companies, can be transformed "into a beverage quite as good, from "the point of view of health, as deep-well water." A better testimonial than this, proceeding from such an expert, could not be desired. But it does not stand alone. In respect to the magnitude of the future supply, it is a matter of some moment to observe that, among the various plans submitted for the employment of extensive storeage reservoirs in the valley of the Thames, the Commissioners give preference to the scheme proposed by Mr. Walter Hunter and Mr. Alexander Fraser—the former a Director, and the latter the Engineer, of the Grand Junction Company. By this plan, nine reservoirs would ultimately be constructed upon land near Staines. The project was approved by Sir Frederick Bramwell, as also by Mr. T. Hawksley, whose long and useful life has just been brought to a close.

The Water Companies throughout the country would doubtless be very glad to support an earnest attempt to amend the law of poor-rate assessment, the manifold anomalies of which the great rating appeal which we reported last week brought once again into prominence. It is noteworthy that it was in a Water Company's appeal that the utterly artificial and unsatisfactory method of rating public works first called forth judicial condemnation. In the case of *The Queen v. The West Middlesex Water-Works Company*, which belongs almost to ancient history, the late Mr. Justice Wightman declared that there was much difficulty in applying the parochial principle of rating to such a class of undertakings. That principle as is well known, necessitates the invention of the hypothetical tenant, and the further invention of a number of far-fetched theories for the purpose of estimating the rent which the hypothetical—not to say impossible—tenant would pay annually for the works, if they were let to him. Later on the same subject engaged the attention of Lord (then Mr. Justice) Blackburn. That most eminent judge endorsed the views expressed by Mr. Justice Wightman; holding that it was practically impossible to make a satisfactory application of ordinary rating rules to the case of water-works or other public undertakings. His Lordship and his colleagues cast about them for some method of rating Companies on a more intelligible basis, which should be capable of uniform application. But the Court found the path of improvement beset with many difficulties; and in the end they regretfully gave up the idea of inaugurating a more sensible system. "We have not, "however, succeeded," said the learned Judges, "in "laying down a rule which would be consistent with "existing legislation and decisions on the subject, and "would at the same time be capable of being satisfactorily "worked; and we are strongly impressed with the import-"ance of not unsettling the law as established by past "decisions, where we cannot lay down a rule which is not "open to exception. On the whole, therefore, we feel "that our only course, until the Legislature shall think fit "to interfere, is to adhere to the case of *Reg. v. The West* "*Middlesex Water-Works Company*." Unfortunately, the Legislature has not thought fit to interfere. The state of things which was condemned in turn by Mr. Justice Wightman and Lord Blackburn years ago survives for condemnation by the Lord Chancellor in 1893. But Lord Herschell shrank from advising the House of Lords to interfere with a long course of practice "supported by "decisions which are not of very recent date." The law, therefore, stands where it did, with all its imperfections thick upon it. The anomalies and inconvenience to which this gives rise, those who have had to do with Companies' rating appeals have again and again had to contend against. Precedent—ancient, complex, and bewildering, —still prevails; competing valuers send the hypothetical tenant from pillar to post, and the Companies have to "pay the piper" for the performance. The Judges confess themselves unable to remedy the evil. Everyone waits for the Legislature; and the Legislature does not "think fit to interfere."

Society of Engineers.—At the next ordinary meeting of this Society, which will be held (under the presidency of Mr. W. A. Valon) on the 2nd prox., Professor Vivian B. Lewes, F.I.C., F.C.S., will read a paper on "Gas Substitutes." It will consist of a general classification of gas substitutes which have been proposed from time to time; a description of oil gas produced by various systems; a discussion of the influence of different methods of burning upon the light developed; and a consideration of water-gas systems and plant, carburetted water gas, and carburetted hydrogen.

The Gas Institute Transactions for 1893.—The volume of Transactions of the Incorporated Gas Institute for 1893 has been published, and may be had of the Secretary, Mr. F. G. Burfield, at the offices of the Institute, No. 13, Victoria Street, Westminster. It is a somewhat smaller book than its precursor in the series, having been lightened of some purely official matter, such as the rules of the Institute, which only added to the cost without enhancing the interest of these annual volumes. The rules, &c., can, of course, be obtained separately by anyone desirous of possessing them. Instead of this formal matter, the present volume contains a classified index of the titles of all papers and communications to the Institute from 1865 to 1893 inclusive, compiled by the Publication Committees of the past and present year.

The Late Professor Heaton.—Mr. Charles W. Heaton, whose death we recorded in the last number of the JOURNAL, commenced his studies first in the laboratory of Dugald Campbell and afterwards under Dr. Stenhouse, in the laboratory of St. Bartholomew's Hospital, where he was fellow-assistant with Professor Kekulé, Dr. Attfield, and the late Professor Tuson, of the Royal Veterinary College, Camden Town. He subsequently acted as assistant and demonstrator in the Royal Veterinary College and at Charing Cross Hospital; and he finally succeeded to the post of Lecturer in the latter institution in 1862—a post which he held up to the time of his death. He held the position of Examiner in Chemistry to the Royal College of Physicians and to the Royal College of Veterinary Surgeons, was Treasurer to the Society of Public Analysts, and filled the office of Public Analyst to the parish of St. Martin-in-the-Fields. Mr. Heaton's personal character was such as to secure for him high esteem and respect; while as a teacher he was kind and painstaking.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 598.)

THE general run of business on the Stock Exchange during the past week has been decidedly quiet. It opened dull; and the tendency was towards lower prices, especially in the less select securities. Consols and the choicer descriptions, however, showed a marked disposition in the other direction, stimulated by a growing cheapness of money in the outside market, and the conviction that the Bank rate would be lowered at the next meeting of the Directors. But as the week progressed, the other markets took a somewhat better turn; the Foreign market being brighter, and the feeling that the coal strike could not be maintained much longer affecting home affairs in a favourable manner. Still, business on the whole was very quiet; and no important movement either way was effected. True to anticipation, the Bank rate was lowered on Thursday to 3½ per cent. In the Gas Market business has not been abundant; but the demand for the issues of the choicer undertakings has been extraordinary, and the advances effected in quotations were on a scale far beyond any which has ruled for a considerable time past. With money abundant, and with dealings in the more speculative markets closed to all but the very daring, the opening afforded for dealing in Gas stocks at recent prices could not fail to attract. The Metropolitan Companies have been especially in demand; and the upward movement commenced with the opening. In Gaslights, business was almost wholly confined to the "A" stock, which rose from 229½ to 233½. The secured issues, though quieter, were very firm; and the "C," "D," and "E" preference and "H" limited made fair advances. The prices offered for South Metropolitans brought a little stock in the market; the figures marked showing a very large improvement upon those of the week before. Commercials also, though they were inactive, commanded materially higher prices. Business in the Suburban and Provincial Companies was very slack; but they shared fairly in the general improvement in point of value—Brentfords, Brighton, and British gaining a point each. Hardly anything was done in Continentals, except Imperial, the quotation of which went up 2. No changes of any sort were marked in any of the rest. The general advance in value of all Water stocks has been very marked, aided largely by the report of the Commission. Each Company has improved from 1 to 8 per cent.

The daily operations were: The Gas Market opened very strong, though business (except in Gaslight "A") was restricted. Quotations at once rose freely. Gaslight "A" advanced 1½; South Metropolitan "A," 5; "B," 1; and "C," 2. Grand Junction Water gained 1½. Tuesday brought no increase of business; but many further advances were scored. Gaslight "H" and South Metropolitan "A" rose 2 each; and Gaslight "A," ditto "C," "D," and "E," both Brentfords, and likewise Brighton, 1 each. Kent and New River advanced 2 each; and East London and West Middlesex, 1 each. Wednesday's transactions were not much more abundant; but the flood tide was still running strongly. Commercial old rose 4; ditto new, 2; and all three South Metropolitans, 2 each. In Water, East London, Kent, Lambeth new, and Southwark advanced 2 each; and Grand Junction and West Middlesex, 1 each. Thursday was quieter still; but further rises were marked of 2 in South Metropolitan "C," and 1 each in ditto "B" and Imperial Continental. Kent Water rose 2. Hardly anything was done in Gas on Friday; but in Water, Lambeth old, New River, and Southwark went up 1 each. Saturday's business was of the usual description; and the only change was a rise of 3 in New River.

ELECTRIC LIGHTING MEMORANDA.

The Price of Edlswan Lamps—More Wild Tendering for Electric Wiring—Fatality at an Electric Light Station—Scientific versus Commercial Considerations.

IT has been announced that the Edison and Swan Company have decided to forthwith reduce the price of their incandescent lamps to 1s. 9d. each, in view of the expiration of their patents next month. This is a good piece of business management, and will doubtless have the desired effect of "taking the wind out of the sails" of the Company's intending rivals. It remains to be seen how much profit there will be in the incandescent lamp trade at competitive prices; but there is fair reason for believing that the Edison and Swan Company will retain the bulk of their customers if they suit their prices to the altered condition of the trade. All experience shows that a business originally established under the protection of a patent will continue to run in the same channels after the monopoly has degenerated into a specialty, provided that the quality of the goods is kept up, and the charge is fairly adjusted. A master-patent is not merely a protection, it is also an advertisement; and in these times when so many businesses are built up on advertisement, and on this alone, it argues bad management if a firm known for many years to have the whole of a particular branch of a trade in their own hands cannot maintain their position. For it is not the patent after all that attracts the business; but simply the desirability of the article patented. Hundreds of perfectly valid patents are obtained every year for articles that afterwards turn out to be not wanted by anybody; and then the patent is commercially worthless. It is the demand for the incandescent lamp that has made the Edison and Swan patent so valuable; and this effect has been brought about by the excellence of the article itself. The quality of excellence has only to be maintained, and the trade will not suffer in volume, although the benefit of a reduced price will be shared between the manufacturer and the purchaser. It is not to be gainsaid that there ought to be a greater demand for a cheap incandescent lamp than there was for a dear one; but it may be doubted whether any such consideration is important enough to affect in a material way the popularity of electric lighting.

Contractors for electric-light fittings are complaining bitterly of the prices which such work just now commands in the open market. There is no longer any specialty in this kind of business, as there was for a year or two when contracts for electrical wiring and fitting were supposed to form a "preserve" for a very select group of firms. Whatever secrets there were in the trade have been exposed; and now the well-known "three-branch hand" has added a fourth dimension to his calling, and makes no more of wiring a house for electric lighting than for electric bells. The inevitable consequence has followed; and work that any tradesman will undertake to do is hardly worth doing. An illustration in point is afforded by the tenders for wiring the Ealing public buildings. Twenty-six competitors entered for this job, and their tenders ranged from £685 to £2187. The accepted tender was for £795, which was the fourth in the list from the lowest. Ironmongers, decorators, gas-fitters, and electrical engineers were in for the contract; and the successful firm are very well known in the electrical trade. Well may it be asked what there was about the job to cause such wild tendering. The facts reveal a condition of the electrical engineering trade that elsewhere manifests itself in connection with the proceedings of the Bankruptcy Court.

The unfortunate London Electric Supply Corporation have lately come into undesirable publicity again in connection with the working of their sub-stations. This time it is not a fire, but the death of one man and serious injury to another that has drawn public attention to the Company's methods. It appears that, at the Blackfriars sub-station of the Company, there are sets of transformers by which the supply current that is sent from Deptford at 10,000 volts is stepped down, to 2400 volts; and it was in cleaning one of the latter which was erroneously supposed to have been put out of circuit, that the two attendants met with the injury that proved instantly fatal to one of them. An inquest has been opened but stands adjourned; and we cannot therefore discuss the accident until all the facts have been established. It appears, however, as an electrical contemporary points out, that this is the second time in this country that a workman engaged upon high-pressure conductors has received a fatal shock; and in each case the only protection has been a rule, the forfeit for breaking which is instant death. "Other accidents not from fatal shocks but from falls, death being indirectly due to the shock, have likewise been due to non-observance of regulations." We had imagined that the death-roll of the high-pressure current system was longer than is here suggested. The generalization that in such cases the only protection has been a rule or regulation is quite in the style of modern criticism, which is nothing if not philosophical. It is a statement, however, which turns out upon close examination to be less satisfactory than it seems to be at first sight. The use of the conveniences of modern civilization is hedged about with cautions and regulations (implied or expressed), transgression of which is visited with death. It will be one of the peculiar difficulties of the electric lighting industry to protect the employees and the public from its hidden dangers, and in this task the tendency of mankind to disregard rules and regulations will have to be reckoned with.

The English people are frequently accused of backwardness in scientific training, and of neglecting scientific considerations in the conduct of their business affairs; and the impeachment is in a measure just. We are a nation of shopkeepers, in the sense that we look at most things from the commercial point of view. But the remarkable thing is that we not infrequently hit upon principles by this means that our more logical and intellectual neighbours on the Continent overlook. The Paris gas-treaty is an illustration in point, where the cleverest French authorities, with every desire to do right, made the selling price of gas depend upon a consideration which does not operate, and ignored that which really governs the matter. So in the settlement of the Antwerp scheme of combined hydraulic and electric supply, a concession for which was recently obtained by the late M. Van Rysselberghe. In justifying his scheme before the Municipality, the promoter argued that, as one-horse power is capable of supplying twelve 16-candle power lamps at the cost of 2·2 lbs. of coal, the coal bill for one such lamp for an hour is only 0·0125d., whereas gas for a burner of equal power costs ½d. with gas at 5s. per 1000 cubic feet. Why is it, then, said M. Rysselberghe, that electricians cannot undersell gas? Simply because of the loss in transmission. Get rid of this, and we shall see—what we shall see. This argument, remarks the *Electrician*, convinced the Municipality, though it did not take into account a source of loss that has made itself painfully felt in this country—namely, the loss due to an irregular demand; nor, we may add, the waste of carrying on a small business by a large and expensive staff.

PROFESSOR NICHOLSON ON THE STATE AND THE INDIVIDUAL.

It is admitted by common consent that the address of Professor J. S. Nicholson, Professor of Political Economy in the University of Edinburgh, who occupied the chair in the Section of Economic Science and Statistics at the recent Nottingham meeting of the British Association, was among the best of the sectional addresses delivered on the occasion. This really masterly composition was briefly mentioned in the editorial columns of last week's JOURNAL; and it is deserving of the close attention of all who are engaged in our great national industries, and who must be occasionally troubled to preserve their foothold upon what they have learnt to regard as the sure ground of economic science, amid the surgings to and fro of so-called "new" opinion respecting the proper treatment of industrial problems. The time has long gone past, if it was ever present, when working people, whether belonging to the ranks of employers or employed, could afford to live in ignorance of economic teachings. Time was, indeed, when the elements of political economy were considered to be "caviare to the general;" and we now see what wild work socialistic agitators are making in the region where the professors of orthodox science have not sought to gain hearers. The "masses" are suffering terribly for listening to the first self-appointed teachers of the science of the market-place, whose vehemence and confidence are in direct proportion to their ignorance; and it is high time, if it is not actually too late, for those who know better to come out from their studies and class-rooms and proclaim the truth at the street corners. It was doubtless a good selection of the British Association Committee to appoint a Professor of Chemistry to lecture to the working men of Nottingham upon such an interesting subject as "Spontaneous Combustion;" but it may nevertheless be regretted that they did not also think of asking some eloquent economist to tell the working man something to help him to think aright about that social and industrial conflagration which socialistic demagogues are trying to promote.

Professor Nicholson set himself to show that the clamourers who are ceaselessly asserting, in the press and on the platform, that the orthodox, or classical political economy has been killed or relegated to Saturn, and that a "new" science of the same order reigns in its stead, are not only mistaken, but that they themselves are already left in the lurch by a marked reaction in favour of the traditional principles and methods first set out by Adam Smith. We are constrained to observe that we should not have suspected the existence of any such reaction; and we can only hope that Professor Nicholson is not deceived in asserting that its hour has struck. The movement was, of course, sure to come sooner or later; and we have been watching and working for it, to the full extent of our powers and opportunities, by strenuously resisting the propaganda of modern socialistic Trade Unionism, and exposing the hollowness of sciolists like Mann and Tillett and Burns, who, notwithstanding their incessant blunderings, have still the ear of the multitude. Reaction is certain, we have argued over and over again, when the failures of what is called Progressivism culminate in undeniable disaster, and the people realize that any lasting amelioration of the common lot is a slow process, only to be secured, if at all, by the old ways. The truths of political economy are true, not because Adam Smith discovered them, or John Stuart Mill expounded them, but because they are inherent in the nature of things; and Progressivism must prove disappointing, not because it is identified with any particular set of expositors, but because it has a false basis, and goes the wrong way to work. When it happens to be allied with something essentially true, which may or may not have been overlooked or misunderstood by the orthodox economists, Progressivism will succeed in justifying itself; but in so doing it merely adds a brick to the old structure. When either a new or an old politicial economist makes a mistake—as Ricardo did in assuming that low wages are essential to cheap production, as other followers of Smith did in assuming economic man to be a monster without a heart, as a modern demagogue does when condoning violence and outrage—then, in all such cases the teaching is vitiated and cannot lead to any fruitful result.

What, asks Professor Nicholson, is the underlying assumption in Adam Smith's procedure, by which he laid the foundations of economic science? It is simply that in economic affairs, in matters of buying and selling in the widest sense of the terms, in satisfying wants by labour, in the accumulation of wealth, there are certain characteristics of human nature that may be regarded as fundamental. These have been elucidated in the first place by the comparative and historical method of Adam Smith; and the principle is now as good as ever. Professor Nicholson gives high praise to Dr. Keynes for his recent effective handling of this method, as well as to Professor Marshall for his treatment of the general subject. Jevons is dismissed with scant appreciation, as an overrated author, "too deficient in philosophical grasp and intellectual sympathy to give the true place to a new conception." The older economists maintained that price was the measure, not of utility, but of value; and that value could not be reduced simply to utility. Things, they said, might have a high value in use, and but little value in exchange. Jevons thought he had discovered a method by which utility might be measured by price; but price is essentially the expression of objective and not of subjective relations—that is the older view in modern phraseology. Price depends upon demand and supply; and utility is one element affecting demand.

One of the greatest merits of the orthodox economists was the careful distinction they drew between economic and other social sciences. For a time, however, especially under German influences, attempts were made to break down these boundaries; and the economist was elevated to the position of universal philanthropist and general provider of panaceas. It is to these excursions that we are indebted for the fantastical notion of the unearned increment, and the curious idea that it is the duty of people to leave the bulk of their money to the State, or rather the duty of the State to take it. Fortunately, however, for the progress of economics, this ideal of breadth without depth has not become dominant, and Professor Nicholson thinks that any force it had is already spent. Still, he admits that to some extent the view prevails, especially in Germany, that it is the business of the economist to discover the general conditions of social well-being, and to show how they may be realized. If such an attempt were seriously made, it could only end in the projection of the personality of the writer into an ideal; and one ideal would succeed another like a set of dissolving views. According to the traditional English view, it is not the business of the economist to decide the first duty of man and the last duty of governments. His sphere is much more limited. Even in England, however, there has been a tendency of late, not confined to professed Socialists, to extend the rule of economics unwarrantably. "Just as the German idealists think it is the business of the economist to discover the way to the perfectibility of the species, the English realists impose upon him the duty of finding the road to the greatest happiness of the greatest number." No doubt, at first sight, this aim seems to be both practical and definite. From the old inquiry, "How nations are made wealthy," to the new inquiry, "How nations are made happy," it seems a natural and easy transition; for it is evident that the happiness of a people is largely dependent upon economic conditions. Professor Nicholson shows how such a transition may readily lead to the abandonment of the central position of the classical economists, and the acceptance of the principle of State Socialism, than which nothing is more opposed to the traditional English political economy.

It is admitted that the old economical rule against State interference with enterprise is not absolute and unqualified; and that there are many matters in which the State must help the individual. But these exceptions were all based on reasoned principles, such as the incapacity of the persons concerned, the lack of individual interest in public works, and the importance of the highest security, as in the regulation of bank-note issues. Strengthened and purified by such exceptions, the presumption remains valid; and Professor Nicholson insists that the onus of proving that it might be expedient to abrogate it in any particular instance, rests upon the party of disturbance. This is precisely how the case stands in regard to the municipalization of gas supply, the expediency of which has to be shown in proving the preamble of Transfer Bills. Having remarked that the movement in favour of State Socialism has made little or no progress of late, and that the analysis of modern industrial systems in which division of labour has become more and more intricate and interdependent has shown the hopelessness of the attempt to transfer the management and control to the State, Professor Nicholson adroitly carries the war into the enemy's country, by demonstrating that, so far from the State showing itself competent to direct the infinite variety of individual enterprise, the latter has convicted modern government and judicial systems of sluggishness and impotency. "Changes in the methods of production, in the diffusion of knowledge, and in the transport of material commodities, have been so rapid and so great, that no executive government could have overtaken them. In the most advanced communities, even that legislation which is necessary for the new conditions lags behind; even those elementary forms which simply aim at giving an interpretation to contracts in doubtful cases, or which are necessary for the adjustment of responsibility (as in bankruptcy and partnership), are behind the times. The growth of joint-stock enterprise has out-stripped the development of the law of companies; and there is a crop of new frauds without corresponding penalties." It looks more as though private enterprise should be called upon to make good administrative deficiencies, than that the State should be entrusted with all the work of the country.

So far from the "new" political economy being an effective advance upon the old, the programme laid down by Adam Smith has not been half carried out. But if the State cannot overtake its first and most obvious duties to the community, how can we possibly justify the assumption of new functions which rest on no better principle than the vague idea that "the State ought to do something?" Professor Nicholson proceeded to argue that the Governments which, in defiance of the warnings of Adam Smith, play experiments in the part of omniscience and omnipotence must, sooner or later, discover their mistake or come to grief. We must not be content with looking at the immediate effects of legislation; the secondary and more remote consequences are also to be considered. State and municipal aid for this and that benevolent scheme is all very well; but

although the limits of tolerable taxation have not yet been reached in Britain, we are fast getting on that way. The general argument may be summarized in the favourite phraseology of the day: "The utility of every increment of governmental work rapidly diminishes, and the disutility of every increment of taxation rapidly increases"—a maxim that should be blazoned in every council chamber in the Kingdom.

The classical economists maintain that, even if the State could do a thing for individuals as cheaply and effectually as they could do it for themselves, it is in general better to trust to individual effort. The decisive consideration is the effect on the character and energies of the people. "Self-reliance, independence, liberty—these were the old watchwords—not State reliance, dependence, and obedience." Lastly, there is the clearest lesson for trade unionists in Professor Nicholson's concluding remarks upon the teachings of history. "Just as Harvey did not invent but discovered the circulation of the blood, so Adam Smith did not invent but discovered the system of natural liberty. And nothing has been better established than the position that legislation which neglects to take account of the liberties of individuals is predoomed to failure. If they cannot break through the law, they will get behind the law." And just as it has become an axiom that the progress of society has been from status to contract, so the liberty of man to make the best bargain for whatever he may have to sell, be it his labour or anything else, is a feature of a higher condition of existence than anything he can possibly enjoy as a mere unit in a Trade Union, bound to follow the orders of his delegate.

Death of Mr. T. Hawksley.—We regret to announce the death on Saturday last, at the advanced age of 86, of Mr. Thomas Hawksley, F.R.S., M.Inst.C.E. Deceased was born at Nottingham in 1807, and at an early age began practice as a civil engineer. As our readers are aware, he devoted special attention to the construction of gas and water works, in which he had larger experience than any other member of the profession. We can only now briefly record the loss which the engineering world has sustained by his death, which occurred after only a week's acute illness; leaving a fuller notice of his life-work for our next issue.

A Timely Suggestion.—A correspondent sends us a suggestion to which it may be opportune to give publicity at the present time, when every industry is, in some way or other, feeling the disastrous effects of the coal miners' strike, and when, as he says, "all colliers who are possessed of any sense at all are wondering why they should pay 2d. per week to take care of 1d., which is what the 3d. levy has shown itself to be." Our correspondent thinks that it would be well for those who have knowledge on the subject, and are at the head of our great coal-consuming establishments, to teach their men sound economic principles by means of leaflets or otherwise. The lessons of the times might well, he considers, be pointed to show who suffer by strikes, who gain by them, where the funds go, how strikes drive trade abroad, and how they can be avoided. Another point, and a most important one, might, he adds, be put plainly before working men in this way—viz., that fluency, fawning, and flattery of the so-called working classes, and abuse of all others, do not, in themselves, guarantee fidelity in a leader. As far as it has been possible to do so in the columns of a technical newspaper, we think we have shown this in the JOURNAL.

Death of Mr. W. Duesbury.—It is with much regret that we record the sudden death, last Sunday week, of Mr. W. Duesbury, Manager of the Cambridge Gas-Works. Mr. Duesbury had not been in good health for some time; and our readers may remember that on this account he was unable to attend the recent meeting of the Eastern Counties Association (of which he was President) at Melton Mowbray. The announcement of Mr. Duesbury's illness evoked from the members expressions of their sincere sympathy with him, and their fervent hope that he would soon recover. These good wishes, however, were unavailing; as he lived for only a few days after the meeting. It appears that he had suffered from weak action of the heart, and therefore had been cautioned not to hurry; but a slight accident which occurred at the works on the 14th inst. caused him, in the excitement of the moment, to disregard the advice, and this is believed to have really been the cause of his death. Mr. Duesbury was a native of Derby; and he entered the service of the Derby Gas Company when he was scarcely more than a child. He displayed such diligence and attention to his duties, that he steadily rose to the position of Manager; and he remained with the Company for 48 years. At the age of sixty he went to Cambridge; but the place did not seem to agree with him. A few weeks ago he spent a very enjoyable time at Yarmouth, and appeared to have benefited therefrom; but after the little trouble already alluded to, he was altogether a changed man. He was found dead at the house of his son, who was his assistant at the works, and with whom he was temporarily residing. Deceased was highly respected by all; and his death is greatly deplored. He leaves a family of five sons and two daughters. The funeral took place at Derby, for which town Mr. Duesbury had a great affection; and we learn that only a few days before his death he remarked that he would like to serve the Cambridge Company for another five years, and then return to his native place.

GAS AND ELECTRIC LIGHT IN MASSACHUSETTS.

WE have received a copy of the eighth annual report of the Board of Gas and Electric Light Commissioners of Massachusetts. The work has been enlarged and extended as compared with its predecessors (notices of which have appeared in our columns), and now occupies some 300 pages. It deals with the affairs of 136 Companies—of which 47 supply gas only, 26 gas and electric light, and 63 electricity—for the year ended June 30, 1892.

During the period under review, four new undertakings have been established for the supply of electric light; while one gas company has obtained leave to enter upon business. Three companies have adopted water-gas apparatus as an auxiliary to coal gas manufacture; one has returned to the practice of supplying water gas only; and one has tried unsuccessfully the manufacture of gas from wood and oil. In the summary of the different disputes that have come under the jurisdiction of the Board, there is some reading that is both amusing and instructive. At New Bedford the amount charged for gas, and the price and quality of the electric light, created much dissatisfaction against the Company, which at present enjoys the right of supplying both systems; and a number of consumers sought to establish a Consumers' Gas Company. Unfortunately, these gentlemen had encumbered themselves with a patent process, by means of which it was claimed that a cheaper and better gas could be produced from oil, water, and air, than was then being supplied. The character of this process may be gathered from the fact that the oil, before use, was to be filtered through a mixture of ground corncobs and ashes of white ash wood; while a certain amount of aqueous extract of potatoes was to be used in the retort. The results of an experimental trial, conducted in the presence of experts appointed by each side, showed that the cost for materials alone would be about 3s. per 1000 cubic feet, and that the gas produced contained 50 per cent. of nitrogen. The advocates of this scheme, having failed to obtain the consent of the Municipal authorities, appealed to the Board against the decision; but their appeal was dismissed, though not without some wholesome advice to the established Company. The Marlborough Gas Company appealed successfully against the permission given by the local authorities for the establishment of a rival Citizens' Gas Company. Many public men were interested in the new venture; and they claimed to be able to make gas much cheaper than existing prices. They had not, however, any satisfactory evidence supporting their assertion.

As a recent Act permits local authorities to engage in the supply of gas or electric light, the Board have issued inquiries as to the action taken; but of 179 official reports from districts numbering 2000 population and upward, 146 have never considered the subject. Twenty-two had taken action previously to the commencement of the year; and of these seven had made no progress. Eight had commenced discussion of the subject during the present year; but there are only three cases in which the actual purchase of plant and the commencement of supply has been carried out. We learn that 24 accidents occurred with illuminating gas, and 18 were fatal. Four of these are stated to have been cases of suicide; and several others are doubtful. Most of them occurred in bedrooms at hotels; and a noticeable feature is the small area of these apartments. One person was sleeping in a room 9 feet by 7 feet by 8 feet high. Particulars are also given of 250 deaths which occurred throughout the States in 1892, from inhaling illuminating gas. Of these, 37 were decided suicides; and the remainder, presumably due to accident. Only 8 occurred with coal gas; 70, with water gas; and the rest, with mixed gas. Judging from European experience, it would appear that many of these so-called accidents are due either to suicides or to the use of small and badly-ventilated sleeping apartments. Seven persons were injured by electricity, four of whom were killed. One of the "accidents" with gas occurred at a gas-works, in consequence of emptying tar into the tar-well at night, by the light of a lantern.

After some particulars as to names of each company, and the various amounts of capital invested, we come to a summary of the revenue accounts, put side by side with those for the previous year; and this enables one to form some idea of the progress of business, or otherwise. The sales of gas to consumers have increased from $5,040,438 to $5,308,118, or about 5 per cent.; but the amount received for public lighting has fallen from $292,544 to $262,777—a decrease of some 10 per cent. The sales of coke have also fallen from $266,581 to $241,288, possibly on account of cheaper coal. Tar has fetched a little more, and liquor somewhat less; but there is a noticeable falling off in the rent of meters. This item stood at $1657 in 1891, and $1392 in 1892; but its total is so small as to show that a large number of gas consumers are either supplied rent free or own their meters. The sums received for rent of stoves, engines, and lamps, amount to $4238—three times as much as the meter-rents. Turning to the expenses, coals have fallen from $1,170,720 to $1,051,727; and enrichers, in about the same proportion—viz., from $266,437 to $243,574. The receipts for residuals represent only a little over 40 per cent. of the cost of the coal; but the latter, including enrichers, is less than one-quarter of the total

receipts for gas. The item of water runs nearly as high as that of purifying materials; and the wages at works is equivalent to half the cost of coals, and more than double the sum devoted to repairs and maintenance. Salaries amount to $375,948; and, therefore, like the wages, run considerably higher than the corresponding item in English balance-sheets. The total profit on the gas business has risen from $1,597,668 in 1891 to $1,907,711 in 1892; and this important increase is due not only to cheaper materials, but to greater economy in purification, wages, and repairs. The returns for gas sold are somewhat complicated by the fact that nearly one-fifth of the whole appears twice, as being sold to other companies before being actually consumed; for it is shown by the items of expenditure, that the gas bought in 1891 cost $842,332, and in 1892 $918,896. The capital expended is large—being some four times as great as the actual income; and the average dividend received on all classes of capital is about 6¼ per cent. The rateable value, amount of taxes paid, and the payment per 1000 cubic feet sold are given for each undertaking. They are extremely variable—ranging from 4 up to 21 cents per 1000 cubic feet; and the average is 6·8 cents.

Seven companies have reduced the price of gas during the year. Large discounts for prompt cash and differential prices are the general rule. There is also a great variation in quality from pure oil gas of 40 to 50 candle power down to 16 or 17 candles. Full particulars as to the quantity of gas made and sold are given. A marked improvement in the matter of unaccounted-for gas is noticeable; but there are still a number of instances showing a loss of 20 per cent. or over. In this connection, there are some interesting tables giving the number of consumers and loss by leakage per mile of main. The average consumption per consumer is large—rarely falling below 15,000 cubic feet. The maximum and minimum daily output are also given; and this in most cases shows a ratio of about 1 : 5, and ranges as high as 1 : 10. According to some details of capital per 1000 cubic feet sold, it appears that the high average above instanced is due to the extravagant capitalization in some half-dozen cases; and that the bulk are not unduly loaded. The returns even embrace the length of each size of main-pipe laid, and the number of meters of each size. The reports of the tests for quality and purity are satisfactory. The average quality of gas supplied is 19¼ candles, which shows an improvement of over 1 candle on previous years. The average sulphur is 9·5 grains, and of ammonia 2·5 grains per 100 cubic feet.

The electric light is dealt with in a manner similar to the foregoing. The total capital invested has increased from $9,931,877 in 1891 to $12,438,857 in 1892. During the same period, the income has increased from $2,440,350 to $2,970,637; and the actual profit, after providing for expenses, from $705,144 to $955,235. But the uncertainty of this line of business is shown by the fact that more than half of the electric light companies have paid no dividend at all. There are several tables, giving statistics as to the dynamos, boilers, number of lamps, length of cables, &c.

The appendices include the detailed accounts of each undertaking; a special report concerning the Boston Gas Company; a copy of a new section of the Act, raising the standard illuminating power from 15 to 16 candles for quality, and allowing no sulphuretted hydrogen and not more than 20 grains of sulphur or 10 grains of ammonia per 100 cubic feet, and fixing the penalty for default, extending over three successive inspections, at $100; and detailed instructions as to the books and accounts to be kept by towns and cities owning electric light plants, including forms of account.

On the whole the Commissioners are to be congratulated on having produced, in a portable and convenient form, a most useful work of reference for the undertakings under their care. It enables any one company to see exactly what its neighbours, and those working under like conditions and with similar materials, are doing, and, by comparison, to detect its own weaknesses. And while specially useful in its own district, the numerous statistics are well worthy the careful attention of all interested in the supply of gas or electricity.

THE POLLUTION OF RIVERS.

In his article in the current number of the *Contemporary Review*, Mr. Frank Spence deals with a subject which is of moment to those who have the control of water-works, and, indeed, to all who are alive to the importance of preserving from contamination one of the main sources of water supply. The well-intentioned enactments which aim at checking river pollution have not proved to be very successful in operation. In London, of course, special steps are taken to test the purity of the supply drawn from the Thames and the Lea; but there are scores of rivers throughout the country furnishing water supply for domestic consumption, but the condition of which is scarcely ever tested by chemical analysis. The law forbids the discharge of sewage matters in their entirety into rivers. Some system of treatment has to be adopted, but in too many instances the method selected is nothing better than a delusion and a snare. The usual run of events is pretty much as Mr Spence describes it in his article on "River Pollution." A growing population demands a sewage system, and the collected result, more or less "treated," is poured into the neighbouring streams. Presently some riparian owner finds that there is an intolerable stench from the stream which runs through his property, or else the local water company, for the protection of their consumers, deem it necessary to resort to legal action. The usual remedy is to obtain an injunction; but when this, after a delay of twelve or eighteen months, is actually granted, the usual practice is to suspend it from time to time, so as to give the offending Board of Health an opportunity of examining competing chemical methods, and making their arrangements for the purpose of abating the nuisance. Mr. Spence suggests that there are Local Boards who, to meet objections on the ground of sanitation, purchase a stock of chemicals, and put a man in charge of their outfall works with strict injunctions to use the material only when the effluent is under the inspection of powerful neighbours; and yet, according to the writer of the article, for an extremely small sum per head per annum sewage can, by chemical precipitation, be rendered as pure and colourless as river water, permanently non-putrescent, and of such a character that the pressed sludge obtained from it shall be without offensive odour, and equal in value, in all respects, to farmyard manure.

What Mr. Spence urges is that there will be no amendment of existing shortcomings in respect of river pollution until a regular system of inspection by officers of the Local Government Board is established throughout the country. Factories, mines, explosives, burial-grounds, railways, canal-boats, and chemical works are all made subject to Government inspection. Why should not drainage works be inspected in like manner? In the Alkali Works Regulation Act, 1884, Mr. Spence finds an example of what might fittingly be enforced in respect of sewage discharge. In regard to alkali works, the object is to guard against pollution of the air we breathe; and, assuredly, there can be no less occasion for protecting the public from pollution of the water they have to drink. "A system which deals so readily with the subtle tainting of the atmosphere might surely," says Mr. Spence, "be applied to liquid discharges, the impurities of which have been so carefully studied and subjected to scientific tests." It cannot be said that any great difficulty would occur in carrying out a system of inspection of sewage works, for their number is not very great. Necessarily all such works are in the hands of a public authority, whose accepted fate it is, and must ever be, to act in other departments of administration under the control of the Local Government Board. Mr. Spence would have it provided that every outflow of waste liquid from sewage works should pass through an open conduit accessible to the Inspector at all hours of the day and night; and he appears to think that, with a few additional assistants, the Chief Inspector under the Alkali Act might well discharge the suggested duties in addition to those which at present devolve upon him. The Chief Inspector under the Acts referred to is always a practical chemist, and it would be quite in the way of his business, the writer of the article thinks, to undertake the sampling of water as well as of air. Again, it can hardly be urged that, if the Local Government Board have the right to require the erection of sewage works, they ought not equally to have the right to see that such works fulfil their object by ensuring a process of practical purification.

It cannot be said that the Local Government Board have shown any indifference to the importance of the present evil; but, on the other hand, they have adopted a "cast-iron" policy which has furnished local authorities with some excuse for postponing the works considered necessary to cure present methods of river pollution. Yet if further legislation is needed to cope with the present difficulties, there may not be much prospect of an early remedy. Mr. Spence, however, quotes the Public Health Act, 1875, by section 293 of which the Local Government Board are empowered "from time to time to cause to be made such inquiries as are directed by the Act, and such inquiries as they see fit, in relation to any matters concerning the public health in any place." This, and subsequent provisions of the Act, Mr. Spence regards as empowering the Board to do that which he urges ought to be done for the protection of the public health. Again, he argues that there is nothing whatever in the Alkali Acts to prevent the Chief Inspector superintending works outside the scope of those Acts. But, on the other hand, we must observe there is the established custom of the Government departments, which is too often regarded as corresponding with the laws of the Medes and Persians, which may not be broken. In these circumstances, though the subject which Mr. Spence has ventilated is well deserving of attention, particularly at the present time, when the possibility of the spread of cholera must needs be reckoned with, we can hardly hope that the Local Government Board will feel called upon to act on outside advice. What is first needed is pressure of public opinion. No doubt when this has attained a certain degree of force, a remedy will be found, if not in one way, in another, for the anomalous and dangerous state of things at present prevailing in respect of river pollution.

Mr. John Calvert, who was one of the founders of the Consett Water Company, and a Director from its inception, died last Friday, at the advanced age of 81 years.

British Association Grants.—Among the usual grants made by the Committee of the British Association is one of £25 to Professor Carey Foster, in connection with electrical standards; and another of £5 to Professor Oliver Lodge, to help forward his movement on behalf of a national physical laboratory.

NOTES.

Proportioning Cement Mortar by Weight.

Speaking in a discussion upon a paper read before the American Society of Civil Engineers, describing the construction of a water-tight masonry dam forming part of the New York water supply system, Mr. T. C. Clarke made a suggestion in regard to the proportioning of cement concrete which has the appearance of being novel. In the work under notice, both Portland and natural rock cements were used; and it came out that at the end of three years a mortar composed of 1 part of Portland cement to 3 parts of sand had very nearly the same strength as a mortar made of 1 part of natural cement to 2 parts of sand. The interesting fact brought out by Mr. Clarke was that in these cases the weight of the cement was also very nearly the same—that is, considering the sand as the unit, the strength of cement mortar made with it depends upon the weight of the cement used. The inference to be drawn is that engineers should specify the use of cement by weight instead of by measure; increasing or diminishing the proportionate weight of cement according as a strong or a weak mortar is desired. The advantages of specifying cement by weight instead of by bulk are that no account need be taken of specific gravity, or the weight of a bushel of cement; and the quantity paid for is always obtained. Mr. Clarke favours seeking economy in concrete construction by embedding rough stones in the mass; taking care to leave sufficient room all round. It would be instructive to hear if any actual experience has been had of gauging the proportions of cement to sand or rubble, for mortar or concrete, by weight instead of by measure.

The Transmission of Heat through Steel Plates.

Much attention has of late been paid to Mr. A. Blechynden's experiments upon the transmission of the heat of gas-flames through steel plates to water on the other side. The apparatus employed in these experiments might be described as a small model boiler, in which the plate under examination was exposed to the heat of gas-jets supplied with a blast, and impinging upon a mass of asbestos lumps such as are used in domestic gas-fires, with the object of ensuring an equal distribution of heat. In experimenting, the gas-jets were first lighted and then regulated to approximate equality, and were permitted to burn for some time, with the top of the furnace covered by a sheet of asbestos millboard or other material until the temperature of the furnace became steady. The cover was then removed, and the boiler, containing a known quantity of water, was put in its place. When the water boiled, the time was noted, and the furnace temperature taken. The apparatus was a sort of calorimeter manipulated so as to show its own heat-capacity instead of the power of the fuel. Mr. Blechynden tabulated his results, which go to prove the broad general fact that the units of heat transmitted through any of the plates per degree difference of temperature between the furnace and the water are proportional to that difference; or, in other words, the heat transmitted is proportional to the square of the difference between the temperatures at the two sides of the plate. It was found that the slightest trace of grease caused a very large fall in the rate of transmission; even wiping the outer surface of the plate with a piece of (oily?) rag or waste was sufficient to influence the result detrimentally. The thinness of the plates, when they are less than $\frac{3}{8}$-inch thick, is not material to the result; but where boiler efficiency is aimed at, the importance of high furnace temperatures is apparent.

The Colours of Natural and Artificial Light.

Captain Abney has contributed to the Royal Society the results of some further experiments made with his colour photometer upon sky light, sun light, cloud light, and candle light. He has made several comparisons of these lights throughout the different parts of their spectra, and has been able to verify their correctness by means of templates rotating in the spectrum of electric arc light, as described in former communications on the same subject. It was endeavoured to express the colours of these various lights in single wave lengths, together with the amount of added standard white light. The result does not appear to have been very conclusive with regard to the artificial light of the candle, although it was found that a close match with this kind of light could be made by adding sodium light to that of the electric arc. Generally, it appears that the dominant light of a blue sky is very nearly the colour of cobalt, although the pigment may require to be mixed with Chinese white to make a match. With regard to direct sunlight, it was found that this contains slightly more green-blue rays than the light emitted from the crater of the positive pole of an electric light. The dominant colour of cloud light, taken from the zenith when the sky was overcast at near mid-day, was between that of the sky and of the sun, as might be expected, and is decidedly whiter than the sky, as might also be anticipated. Captain Abney adds, with regard to observations of the light of a candle, that a large number of separate observations are required of the part of the spectrum in which the dominant colour is to be found, in order to get a good and fairly trustworthy mean. From this it may be gathered that the light of a candle is not much more to be relied upon for the purposes of colour photometry than it is for light measurement.

COMMUNICATED ARTICLE.

COAL GAS: ITS MANUFACTURE, DISTRIBUTION, AND CONSUMPTION.

A Series of Articles for Gas Students.

CONSUMPTION.

(*Continued from p.* 489.)

II. Conditions Favourable to Perfect Combustion, and their Application to Burner Construction.

"The intensity of light from flame depends principally upon the production and ignition of solid matter in combustion." This theory of the luminosity of flames was propounded by Sir Humphry Davy, as far back as 1817. It has been repeatedly assailed by eminent investigators, whose researches, however—while proving conclusively that certain factors (such as the density of the atmosphere surrounding the flame, the temperature of the latter, and other like conditions) have an important bearing upon its luminosity—have completely failed to shake the original theory.

For the development of light in an ordinary gas-flame, the presence of solid matter in combustion is therefore essential. Hence, then, the necessity for so disposing the flame as that the hydrogen shall burn first, and by the heat thereby generated decompose the hydrocarbons, and raise the solid particles to incandescence prior to combustion. The experiments above referred to show that the higher the temperature of the flame, also the greater the density of the surrounding atmosphere, the higher will be the illuminating power, and *vice versa*. "The difference of an inch in the barometric column makes 5 per cent. difference in the luminosity. A burner giving 100 units of light with the barometer at 30 inches, would only give 95 units if it fell to 29; while a rise to 31 inches would mean an increase of the luminosity to 105 units" (Lewes). Then, again, moisture in the air will prejudicially affect the light. Excessive pressure of gas at the burner-tip is a certain preventive of perfect combustion. In such case, much of the gas is rushed through the flame, and into the surrounding atmosphere, only partially decomposed—much less completely oxidized—with the production of acetylene and carbonic oxide, both of which gases are highly injurious to animal life. As already noticed, the presence of air in the flame tends to reduce its luminosity; and this whether the air be admitted to the interior or simply brought into contact with the flame. An apt illustration will be found in the soot and smoke produced by wind, or gusts of air, on the ordinary naked flat gas-flames used in open shops, &c. The liberated carbon is so cooled by the gusts of wind as to be below the temperature at which it can combine with the oxygen of the air; hence a steady, regular, and sufficient, but not an excessive supply of air is a *desideratum* in economical and satisfactory coal gas consumption. Another consideration is the removal of products of combustion. To a certain extent this is effected by the light itself, in the upward currents of air set up by the heat and heated vapours of the flame. If these be not properly carried away, however, the air will become vitiated, and (not to speak of the depressing and injurious effect on human kind) the luminosity of the light will soon be materially reduced. Of course, this condition obtains more than ever with enclosed lights, as of the regenerative types. The injurious effects on the light of carbonic acid and water vapour have already been noted.

Lastly, as in most chemical operations, the perfection of coal gas combustion is enhanced by not being hurried. A well-formed flame—with just sufficient pressure of gas to enable it to retain its form perfectly—carefully shielded from draughts and an undue supply of air, and allowed to burn quietly at the rate at which the burner orifice will readily pass the gas, will give the best results. There is a point at which all burners will give their best results. Exceed this, and the rush of gas prevents complete combustion, and also draws air with it, to the detriment of luminosity. If the rate of consumption be not equal to the capacity of the burner, the flame becomes sluggish, irregular in shape, and jumps; and, not setting up a sufficient draught of air around, the gas is not properly consumed, and the flame smokes. As Mr. R. H. Patterson put it in the article on "Gas-Burners" in "King's Treatise," Vol. III.: "It may be stated, as a general rule—in the case of Argands with absolute correctness—that, however widely burners differ as regards the amount of light which they give from gas, every burner gives its *own* maximum of light per foot of gas just at the point, or rate of consumption, when its flame is about to smoke."

From the foregoing, it will now be seen that, in the construction of a good lighting burner, the following conditions must be observed and provided for: (1) Complete combustion of the gas; (2) the maintenance of a high temperature of combustion; (3) a careful regulation of the gas supply to the capacity of the burner; (4) the same as regards the air supply, and prevention of draughts, &c., to the flame; and (5) efficient ventilation.

It may be convenient at this point, before applying the principles above enunciated to burner construction, to note the three types of illuminating flames in general use. These are the flat flame, as produced from the well-known batswing or slit burner and the fishtail or union-jet burner; the Argand; and

that produced in the ordinary form of regenerative lamp, which is practically a form of Argand flame. The incandescent burner is beyond the scope of the present remarks, insomuch that the light produced is not obtained (except indirectly) from coal gas. The latter, burning with a non-luminous Bunsen flame, raises to incandescence a foreign substance, which latter is the direct luminant. This substance is woven in delicate threads into a "mantle," under which the Bunsen flame burns. The light that is afforded by the lamp is effective and pleasing.

With ordinary coal gas, the Argand flame gives a higher candle power per foot of gas consumed than the flat flame, whether from fishtail or batswing burner; but the reverse is the case with cannel gas of from 20-candle power upwards. It will be observed that the flat flame, being totally unprotected, is much more sensitive to any slight variations of atmospheric conditions on passing currents of air—any malformation of the proper shape of flame being also a certain indication of some interference with perfect combustion; whereas the Argand flame is not only protected from these disturbing influences, but we have in the chimney a means of adjusting the air supply to a nicety, according to the requirements of the consumption and the quality of the gas.

Now with reference to the principles of burner construction. The first of the five conditions above-named is really dependent upon the due observance of the third, fourth, and fifth. The second one is to be considered in a two-fold sense—directly and indirectly. First, indirectly by the avoidance of every condition that may tend to reduce the flame temperature. In this category is the class of burner utilized. A metallic burner being a good conductor, will convey heat downwards almost as fast as it is generated, and thus rob and cool the flame to an enormous extent. To this is attributable the extended area of the "dark central zone of the unburnt gases" where this type of burner is in use. Hence the introduction and adoption of adamas, steatite, and other burner-tips made of non-conducting material. Then, again, an excessive pressure of gas at the burner-tip, by causing the gas to draw with it currents of air which ultimately mix with it in the flame, considerably lowers the flame temperature; and it also produces a like effect in overburdening the flame, as it were, with a greater rush of cold gas than can be completely consumed. This condition is therefore (similarly to number one) subject to a proper observance of the third and fourth. Secondly and *directly*, by the employment of means calculated to increase the heat of the flame. The duplex burner was introduced with this object. The heat radiated from each flame helps to maintain the temperature of the other, and the air supply between the two flames is heated; so, theoretically, the twin flames give an illuminating power somewhat in excess of the sum of the two flames individually. On the other hand, however, it must be stated that each flame presents an obstacle to the passage of light from its fellow—the amount of light absorbed in passing through the wall of flame being computed at from 23 to 26 per cent. Moreover, the disadvantages attending the sensitiveness of flat flames to atmospheric disturbances, are simply doubled in this burner. The same applies in a less degree to the principal cause of the low service yielded by the flat flame —*i.e.*, the large surface of flame exposed to the cooling action of the air. The Argand burner is much better fitted for the maintenance of a high flame temperature, as, being circular and self-contained, one part of the flame helps by radiation to keep up the temperature of that continuously adjoining. There are but two sides of the flame exposed to the air (and that heated air) instead of four, and no edges, as with flat flames; and the whole of the air supply is more or less heated, whilst the amount admitted can be regulated to the exact requirements by the length of the chimney. The loss of light by absorption through the circular wall of flame has to be taken into consideration with this burner also; and it is probably somewhat more than with the duplex. The modern regenerative lamp, however, carries this principle of high flame temperature much farther, and, in fact, almost (if not quite) to its utmost limit. This is effected by intensely heating both gas and air prior to their admission to the burner orifice, and the complete exclusion of cold air from the flame. The effect is an enormous increase of candle power per cubic foot of gas consumed. The construction of these burners is necessarily somewhat complicated and expensive; and hence the principle has been partially applied in another series of lamps, where the gas *only* is heated. These lamps, whilst giving very high results, do not, of course, attain to the duty of those just mentioned.

The three last mentioned conditions—viz., the proper regulation of gas and air supplies and the ventilation of the lamp—have already received attention. Needless to say that, in the construction of the high-class lamps above referred to, these points have to be most carefully considered. The matter of ventilation, however, often has to embody not only the removal of the products of combustion attending the lamp flame itself, but also the renewal of the atmosphere of the building in which the lamp is placed—vitiated, it may be, by the united exhalations of hundreds of human occupants below. The well-known sun-burner has done yeoman service in this connection. This burner also embodies the principle of heating the gas prior to combustion, as the supply-pipes pass through the chamber above the lights, through which the whole of the heated products of combustion are passing away. The heat which necessarily attends the combustion of the gas, and the currents of air thereby set up, are utilized in the ventilating burners for carrying off the heated vapours from below; fresh-air inlets being provided at suitable positions much lower in the hall—probably about 6 feet from the floor.

The following figures are from the fifth of the 1890 Cantor Lectures, already referred to.* They clearly indicate the respective capabilities for developing light from the gas consumed, of the three types of burners named.

	Illuminating Power in Candles per Cubic Foot of Gas Consumed.	Products of Combustion per Candle Power. CO_2	Water Vapour.
Batswing	2·9	0·18 c. ft.	0·46 c. ft.
Argand	3·3	0·16 „	0·4 „
Regenerative	10·0	0·05 „	0·13 „

The next table shows the amount of oxygen used up, and the products of combustion formed, by each class of illuminant and burner, in illuminating a room (say) 16 ft. by 12 ft. by 10 ft. with (say) 20-candle power; and giving also the number of adults who would exhale the same amount during respiration.

Illuminants.	Materials used. Grs.	Oxygen Removed. C. Ft.	Products of Combustion Water Vapour. C. Ft.	CO_2 C. Ft.	Adults
Sperm candles	3840	19·27	13·12	13·12	21·8
Paraffin oil	1984	12·48	7·04	8·96	14·9
Gas (London)	C. Ft.	C. Ft.	C. Ft.	C. Ft.	
Batswing burner	11·0	13·06	14·72	5·76	9·6
Argand „	9·7	11·52	12·80	5·12	8·5
Regenerative „	3·2	3·68	4·16	1·60	2·6

(To be continued.)

TECHNICAL RECORD.

PROFESSOR SMITHELLS ON FLAME.

One of the Lectures usually given in connection with the meetings of the British Association, was delivered in the Albert Hall, Nottingham, on Friday, the 15th inst., by Professor SMITHELLS, of Leeds; the subject selected by him being "Flame."

The lecturer began by saying that the first accurate knowledge of the nature of flame seemed to have been gained about the beginning of the Seventeenth Century. After alluding to the mystery which in ancient times had surrounded the subject, he remarked that the recognition of flame as being essentially burning gas was due to Van Helmont, who lived about 1600. Hooke, half a century later, gave a more complete account of flame, and especially of the part played by the air in promoting combustion. The exact chemical nature of the process was only arrived at by Lavoisier at the end of last century. The next important step in the history of the subject brought us to the memorable researches of Humphry Davy. He recognized the connection between flame and explosion—a relationship which the lecturer illustrated by experiments, and which showed that flame might be regarded as a "tethered" and continuous gaseous explosion.

Dealing next with the Bunsen burner, Professor Smithells showed that the feebly-luminous flame produced by it was, in reality, separable into two parts. Using a Bunsen burner with a long glass tube, instead of a short metal one, he demonstrated that, by increasing the amount of air added to the gas before combustion, the inner cone of the flame separated from the outer one, and descended the glass tube. All the air entering the tube was used in the first flame; and the excess of gas formed a second flame on reaching the free air at the top of the tube. By careful adjustment, the moveable cone of flame was made to take up any desired position. He then showed that the two parts of the flame could be fixed apart from one another by slightly constricting the glass tube at one point; also that, when the inner cone was about to descend into the tube, it could be brought down by thrusting a glass rod vertically up the tube till it touched the cone. On pulling down the rod, the cone became inverted, and then followed the rod. A more convenient appliance was found in two tubes of different diameter—one sliding within the other. By means of this, the inner cone was obtained on the inner tube, and the outer cone on the outer tube; and the flame could be dissected or reconstructed at will. The inner cone was proved to be much hotter than the outer cone. When the fine dust of a salt of copper was introduced into the gas, it was seen that the green coloration was confined to the outer cone, and depended on the existence of the oxide of copper, which was impossible in the inner cone.

Proceeding to consider in detail the structure of flame, the lecturer showed that the simplest flame—such as that of hydrogen or carbon monoxide—consists of a single hollow cone of flame. Whether the light of the flame was due to the mere degree of heat of the gases or to something in the nature of atomic electrical discharge, was, he said, a moot point on which we should probably learn more before long. Dealing next with a gas which might burn in two chemical steps, Professor Smithells showed that, in the flame of cyanogen, the red inner part was due mainly to the formation of carbon monoxide, and the outer

* See JOURNAL, Vol. LVI., p. 1335.

one to this carbon monoxide burning to form carbon dioxide. This was proved by the use of the flame-dissecting apparatus. Proceeding to ordinary flames produced by hydrocarbons, or mixtures of hydrocarbons, he demonstrated the existence of three distinct parts, all of which were thin sheaths—first, a bright blue part, visible at the base of the flame; secondly, the bright yellow part; and, thirdly, a faintly luminous lilac mantle investing the whole flame. The development of these parts of flames was shown by means of a series of lantern slides made from actual photographs. In a very small flame the blue and lilac parts were seen as complete cones; in a somewhat larger flame, the blue cone was interrupted by the appearance of a yellow patch; and as the flame was enlarged this patch rapidly overshadowed the other parts, both by its brilliancy and extent. It was next shown that the blue and lilac parts of the ordinary luminous flame correspond to the two cones of flame produced by a Buusen burner. The chemical changes taking place in these two cones were next discussed; and it was demonstrated that, when the gas is starved of oxygen, it is the hydrogen and not the carbon that is left unburned. The products from the inner cone of a Bunsen flame, or the blue cone of an ordinary luminous flame, contain free hydrogen and carbon monoxide; and these gases pass on to burn in the outer cone of the Bunsen flame, or the lilac mantle of an ordinary flame.

The production of the luminous yellow part of flames was next discussed; and Davy's experiments with wire gauze, which led him to the conclusion that the luminosity was due to the separation of solid carbon, were repeated. After referring to Dr. E. Frankland's experiments on the luminosity of flame, the lecturer said that Davy's theory still held its ground, though he believed Dr. Frankland had not yet said his last word. Alluding to the mode in which the carbon is separated in flames, the lecturer said that Davy had often been supposed to imply that the separation was due to a deficiency of oxygen in the middle of the flame, which led to the competition between the hydrogen and the carbon—the former having the advantage. This was not justified by Davy's words; and, at any rate, it was opposed to established facts. The cause of the separation of the carbon was to be sought in the intense heat produced by the combustion in the blue and lilac parts of the flame. The hydrocarbons within, being thus roasted, deposited carbon just as they did when they were passed through hot tubes. The theory of luminous flames advocated by the lecturer was epitomized in an experiment with benzene vapour burnt in the flame-dissecting apparatus. The benzene could be burnt in a single cone of pale flame if much air were previously mixed with it, and in two cones if rather less air were added. If still less air was added, carbon separation began in the centre of the flame, even while the cones were still separated.

In conclusion, Professor Smithells said that in past ages the earth had in all probability been the scene of flames of colossal proportions. It was known to be a cooling body, and also an oxidized body. At one time it must have been too hot for the oceans to have existed in a liquid state; and at a still more remote period, all the waters of the earth probably existed as an enormous gaseous envelope of uncombined hydrogen and oxygen. It was a chemical necessity to imagine an intervening time at which this hydrogen and oxygen would begin to combine. In this way it was not improbable that hugh cosmical flames would rend the atmosphere. The steam formed, descending to the hotter strata of this pregeologic atmosphere, would be dissociated and sent forth again. In like manner many other oxidized compounds now constituting the outer crust of the earth would at one time be existing as uncombined gaseous elements in the atmosphere. For untold years, when the earth was still a glowing ball, it must have had a vast atmosphere, which was, in all probability, the scene of incessant celestial pyrotechny. It was startling to think how much the earth at that time must have resembled the sun, as the solar physicists know it at the present time. It was rash to hint at such a thing, but, if oxygen could be found in anything like abundance round the sun, there might be some cause to imagine that it not only looked like the fiery earth of bygone days, but had much in common with its chemical history. The chemical theory of the sun's heat had long since been disproved, and ordinary laboratory chemistry banished it from that luminary as altogether unsuited to its temperature. But one might be excused for expressing surprise, in view of the unity of plan in which heavenly bodies "move and have their being," that the sun should not exhibit the possession of a fair share of oxygen—the element which had ruled the earth's chemistry throughout all geological times and long precedent ages of its evolution.

Lyon's New Gas Rent-Roll.—At the recent meetings of the South-West of England and Eastern Counties Gas Associations, Mr. J. H. Lyon, of Malvern Link, showed a new arrangement of gas rental-book. It has been designed to admit of as much detail as possible being entered up; thus giving, at a glance, the fullest information as to the state of any consumer's account, without taking up, when open, a large amount of desk room. The special feature of the book is that the leaf for the June and September quarters is not so wide as those for March and December; consequently, the names of consumers require to be re-written only once a year.

PROFESSOR LEWES ON SPONTANEOUS COMBUSTION.

As already mentioned in the JOURNAL, the usual lecture to working men, which forms a by no means unimportant item in the programme of the British Association meeting, was this year entrusted to Professor VIVIAN B. LEWES, F.I.C., F.C.S., who selected the above subject for his discourse.

The lecturer began by stating that, when an inflammable substance ignites or becomes incandescent without the application of fire or other apparent cause, it has been customary to speak of it as "spontaneous combustion"—a term which he thought he should be able to show does not correctly express the actions leading to this apparently mysterious result. He then proceeded to refer to the experiments carried out by Priestley and Lavoisier in the last century, which disposed of the theory then generally accepted, that every combustible body contained within itself the products of combustion, combined with something called "phlogiston," and that, when the substance was burnt, this phlogiston escaped—giving the flame or incandescence of combustion, while the products were set free. Lavoisier showed that air consisted of two gases—oxygen and nitrogen—and that anything which would burn in air would burn with still greater vigour in oxygen; while nitrogen alone instantly stopped the combustion of the bodies requiring air to enable them to burn. The enunciation of these truths by the great French philosopher was one of the most important steps in the history of science; but Professor Lewes pointed out that, with increase of knowledge, we find that we must still further widen our views with regard to combustion, and must take care not to fall into the error of looking upon those substances which will burn in air or oxygen as the only combustibles, and oxygen as the only supporter of combustion. These terms were, in fact, purely relative; and a substance which was looked upon as a combustible might, under altered conditions, become a supporter of combustion. Indeed, a body like coal gas, which burns in air or oxygen, would support in turn the combustion of air; and it could, he said, be experimentally shown that it was just as easy to have a flame of air burning in coal gas, as, under ordinary conditions, to have a flame of coal gas burning in air. If all cases of combustion were carefully examined, it would be found that in them there was a body with certain definite properties of its own, uniting itself with something else to form what were called the "products of combustion," which were equal in weight to the sum of the weights of the two bodies uniting, and had characteristic properties differing from those of the original substances. This action might be termed one of chemical combination; and extended experiments showed that, in order to obtain a true conception of combustion, it must be looked upon as "the evolution of heat during chemical combination." In many instances, the process was so slow that the heat evolved escaped notice; and the action was then called "slow combustion." This was in all cases accelerated by increase of temperature; and the higher the temperature, the more rapid became the chemical action. All combustible bodies at a certain degree of heat would undergo ignition. Then the temperature was reached at which slow combustion passed into ordinary combustion, with manifestation of flame or incandescence—the chemical combination being then so rapid that the heat evolved was manifest to the sight. A still greater increase in speed would in some cases bring about the most rapid form of combustion—viz., explosion. It was the change from the little noticeable slow combustion to ordinary combustion to which the term "spontaneous combustion" had been given.

Professor Lewes then passed on to consider special cases of spontaneous combustion. He pointed out that, when the combustible substance has a great affinity for oxygen, and at the same time a low point of ignition, spontaneous combustion will easily take place. Certain bodies have the power of absorbing many times their own volume of gases; and, in doing this, they not only give rise to a certain increase in temperature, due to the compression of the absorbed gas upon their surfaces or in their pores, but also to greater chemical activity of the gas so compressed. Carbon is one of those substances which possess to an extraordinary degree the power of attracting and condensing gases upon their surface; this power varying with the state of division of the particular form of carbon used. The charcoal obtained from dense forms of wood—such as box—exhibits this property to a high degree. The lecturer said there were several interesting points with regard to the spontaneous combustion of charcoal which called for more attention than had been devoted to them; and we therefore reproduce in full the portion of his discourse dealing with this subject, and that of the spontaneous ignition of coal which followed it.

It is self-evident, he said, that, the more porous a body is, the greater amount of exposed surface will be available for the condensation of gases; and the great power which charcoal has of absorption is undoubtedly due to its great porosity. The temperature at which wood can be carbonized varies very considerably; and wood will begin to char—that is to say, will begin to be converted into charcoal—at temperatures very little above that of boiling water. Charcoal formed at this low temperature, however, still contains large quantities of hydrogen and hydrocarbons, and is not nearly so porous as charcoal made at a high temperature; and although the diminution in

porosity makes it less susceptible to spontaneous combustion due to the heat produced by the condensation of gases, yet another cause which tends still more to dangerous rise of temperature comes into play. When a substance condenses oxygen upon its surface from the atmosphere, the gas is in a very chemically active condition, and will bring about chemical combination with considerable rapidity. For instance, if a piece of platinum foil is heated to redness, so as to drive off all gases from its surface, and is then allowed to cool until it ceases to be visibly red, and is held in a stream of mixed air and coal gas, or air and hydrogen, it again becomes red hot, owing to the chemical combination of these substances upon its surface—that is to say, it has been able to condense these gases together, and set up combustion. If charcoal is burnt at a high temperature, the carbon is in a dense condition, and resists to a considerable extent the setting up of chemical action by the oxygen condensed and absorbed in its pores. But if it has been formed at a low temperature, this condensed oxygen will rapidly act upon the hydrocarbons and hydrogen still remaining in the mass, and will in this way raise the temperature to a dangerous point; and it is more than probable that very many unexplained fires have been brought about by beams and woodwork becoming charred in contact with flues and heating-pipes. It has been experimentally determined that, when wood has been charred at 500° Fahr., it will take fire spontaneously when the temperature is raised in the presence of air to 680°; and that, when wood has been carbonized at 260°, a temperature of 340° only is required for its spontaneous ignition. If a beam is in contact during the winter months with a heated flue, or even with steam-pipes, it becomes carbonized upon its surface; and during the summer, when the flue or pipe is probably not at work, it absorbs air and moisture. During the next winter, it again becomes heated and further carbonized, while the moisture and air are driven out; leaving the pores in a condition eminently adapted for the absorption of more air as soon as the temperature is allowed to fall. In many cases, sufficient heat is generated to cause the charred mass to smoulder, and to burst into flame when air is freely admitted to it. In the case of charcoal burnt at a high temperature, it may be taken that the cause of heating is almost entirely physical; while, in the low-burnt charcoal, it becomes chemical as well as physical. It is this chemical action which is the most dangerous, and acts in the majority of cases of spontaneous combustion.

The spontaneous ignition of coal has been the cause of an enormous number of serious accidents; and the earliest theory as to its cause was that it was due to the heat given out during the oxidation of the pyrites or "coal brasses," which are compounds of sulphur and iron, and are present in varying quantities in nearly all coal. This idea has held its ground nearly up to the present time, in spite of the researches of Dr. Richters, which some twenty years ago showed that the explanation was an erroneous one. Even earlier, in 1864, Dr. Percy pointed out that the cause of spontaneous ignition was probably the oxidation of the coal, and that the pyrites had but little to do with it. Pyrites is found in coal in several different forms—sometimes as a dark powder closely resembling coal itself, and in larger quantities in thin golden-looking layers in the cleavage of the coal; at others in masses and veins of considerable size. These masses, however, are very heavy, and are carefully picked out from the coal and utilized in various manufactures. The yellow pyrites, and even the dark varieties when in the crystalline form, remain practically unaltered, even after long exposure to moist air; but the amorphous and finely-divided portions oxidize and effloresce with great rapidity. It is during this oxidation that the heat is supposed to be generated. Some coals that are very liable to spontaneous ignition only contain 0·8 per cent. of pyrites; and if we imagine this to be concentrated in one spot, instead of being spread over the whole mass, and to be oxidized in a few hours, the temperature would rise only a few degrees. Under ordinary circumstances, this would be practically inappreciable.

The oxidation of masses of pyrites under certain conditions gives rise to the formation of ferrous sulphate and sulphur dioxide, with liberation of sulphur; and one might easily imagine that this free sulphur, which has an igniting-point of 250° C., would play an important part in the action, by lowering the point of ignition. This, however, could only happen with large masses of pyrites undergoing oxidation; and, with the small amount of pyrites in coal, supposing air were present in sufficient quantity to oxidize it, the sulphur formed would be converted into sulphur dioxide at temperatures as low as 60° C. This oxidation of sulphur at low temperatures is an action not generally known; but, in my experiments, I have found it takes place with considerable rapidity. The only way in which pyrites can assist the spontaneous ignition of coal is that, when it oxidizes, it swells, and splits up the coal; thus exposing fresh surfaces to the action of the atmospheric oxygen. I have carefully determined the igniting-points of several kinds of coal, and find that cannel coal ignites at 698° Fahr. (370° C.); Hartlepool coal, at 766° Fahr. (408° C.); lignite coal, at 842° Fahr. (450° C.); and Welsh steam coal, at 870° Fahr. (477° C.). So that it is impossible for the small trace of pyrites scattered through a large mass of coal, and slowly undergoing oxidation, to raise the temperature to the necessary degree. When coal is heating, a distinctive and penetrating odour is evolved, which is the same as that noticed when wood is scorched; and the gases produced consist of nitrogen, water vapour, carbon dioxide, carbon monoxide, hydrocarbons of the paraffin series, and sulphuretted hydrogen—the presence of the latter gas showing beyond doubt that oxidation of the sulphur has nothing to do with the action.

Ever since coal has been generally adopted as a fuel, it has been recognized that great care was necessary in the storing and shipment of masses exceeding 1000 tons; and if the coal has been stored wet or in a broken state, firing or heating of the mass has frequently taken place. Much inconvenience and loss have been caused by this on shore; but the real danger has occurred during shipment. In consequence of this many a vessel has been lost with all hands, without any record of the calamity reaching shore. Owing to the greater facility for treating the coal when it becomes heated on shore in coal-stores and gas-works, absolute ignition only rarely takes place; and it is mainly from evidence contained in the case of coal cargoes that we learn most as to the causes which lead to it.

Coal is a substance of purely vegetable origin, formed out of contact with air, by long exposure to heat and pressure, from the woody fibre and resinous constituents of a monster vegetation which flourished long before the earth was inhabited by man. Coal, therefore, may be looked upon as a form of charcoal, which, having been formed at a temperature lower than that of the charcoal-burner's heap, and under great pressure, is very dense, and still contains a quantity of these constituents which, in the ordinary burning, are driven off as wood naphtha, tar, &c. These bodies consist of compounds containing essentially carbon and hydrogen, together with a little oxygen and nitrogen, and form the volatile matter and hydrocarbons of the coal. Besides these, coal also contains certain mineral bodies, which were present in the fibre and sap of the original wood; and they form the ash which is left behind on the coal being burnt. These mineral substances consist almost entirely of gypsum or sulphate of lime, silica, and alumina, together with some oxide of iron, which gives the colour to the reddish-brown ash of many coals, and which has been formed by the decomposition of the pyrites in the original coal. The mineral constituents of coal are the only ones, with the exception of the pyrites, that do not play any part in the phenomena attending the heating and spontaneous ignition of coal; and we must therefore only regard the actions which take place when the carbon, hydrocarbons, and pyrites in freshly-won coal come in contact with air and moisture.

Certain kinds of coal exhibit the same power of absorbing gases which charcoal has, although to a less degree. The absorptive power of new coal due to this surface attraction varies; but the least absorbent will take up one-and-a-quarter times its own volume of oxygen, while in some coals more than three times their volume of the gas is absorbed. This causes a rise in temperature, and tends to increase the rate of the action which is going on; but it is rarely sufficient to bring about spontaneous ignition, as the fact that only about one-third of the amount of oxygen is absorbed by coal that is taken up by charcoal, and that the action is much slower, tends to prevent the temperature reaching the high ignition point of the coal.

All coal contains a certain proportion of hydrogen, with which some of the carbon is combined, together with the nitrogen and oxygen—forming the volatile matter in the coal. The amount of this volatile matter varies greatly. Anthracite contains the smallest quantity, and cannel and shale the largest. When the carbon of the coal absorbs oxygen, the compressed gas becomes chemically very active, and soon commences to combine with the carbon and hydrogen of the bituminous portions—converting them into carbon dioxide and water vapour. As the temperature rises, this chemical activity increases; so that the heat generated by the absorption of the oxygen causes it to rapidly enter into chemical combination. This kind of chemical combination—oxidation—is always accompanied by heat; and this further rise of temperature helps the rapidity of oxidation, so that the temperature goes up steadily. This, taking place in a large mass of coal, which from physical causes is an admirable non-conductor, will often cause such heating of the mass that, if sufficient air can pass into the heap in order to continue the action, the igniting-point of the coal will be reached. It has been suggested that very bituminous coals, such as cannel and shale, are liable to spontaneous ignition from the fact that heavy oils would exude from them on a rise of temperature; and that these, by oxidizing, might produce rapid heating. Experiment, however, shows that this is not the case, and that the heavy mineral oils have a decided effect in retarding heating.

We can now trace the actions which culminate in ignition. As soon as the coal is brought to bank, absorption of oxygen commences; but, except under rare conditions, the coal does not heat to any great extent, as the exposed surface is comparatively small, and the largeness of the masses allows of the air having free access to all parts, so keeping down the temperature. After the coal has been screened, and the large pieces of pyrites have been picked out, it is put in trucks. Here it begins to be broken up, owing to the many joltings and shuntings, and so offers a larger surface to the action of the air. When it has arrived at the ship, it is further broken up by being shot down the tips or shoots; and more harm is done at this than at any other period, for the coal is broken by reason of

the distance it has to fall, and it has to bear the impact of every succeeding load falling upon it. Consequently, it rapidly becomes slack; so that the under part of the shipload is a dense mass of small coal, which soon rises in temperature by reason of the large surface exposed to the air and the consequent absorption of oxygen. This sets up chemical combination between the oxygen taken in by the coal and the hydrocarbons, and in some cases culminates in combustion.

It is found that the mass of coal exercises a most important action in the liability to spontaneous combustion, as, although with 500 tons of coal to the cargo the cases amount to only about one-fourth of 1 per cent., when the bulk is increased to 2000 tons they rise to 9 per cent. This is due to the fact that the larger the cargo, the more non-conducting material will there be to keep in the heat; and also to the fact that the breaking up of the coal and the exposing of fresh surfaces will, of course, increase with augmentation in mass. It is also found that coal cargoes sent to European ports rarely undergo spontaneous combustion; while the number of cases rises to a startling extent in shipments made to Asia, Africa, and America. The result is partly due to the length of time the cargo is in the vessel; the absorption and oxidation being a comparatively slow process. But the main cause is the greater heat in the tropics, which causes the action to become more rapid. If statistics had been taken, most of the ships would have been found to have developed active combustion somewhere about the neighbourhood of the Cape; the action fostered in the tropics having raised the temperature to the igniting-point by that time.

Moisture has a most remarkable effect upon the spontaneous ignition of coal. The absorption of oxygen is at first retarded by external wetting; but after a time the presence of moisture accelerates the action of the absorbed oxygen upon the coal, and so causes a serious increase of heat. The researches of Cowper, Baker, Dixon, and others, have of late years so fully shown the important part which moisture plays in actions of this kind, that it is now recognized as a most important factor. A very marked case of the influence of moisture came under my notice a few months ago. A ship took in a cargo of coal at a South Wales port; the weather being fine and dry while she was loading at the main hatch, but wet while she was taking in the coal at the after hatch. The result was that the temperature in a few days was uniformly about 10° higher in the coal loaded wet than in the dry portion of the cargo; spontaneous ignition being the final result at the after hatch.

In order to prevent the spontaneous ignition of large masses of coal, it is manifest that every precaution should be taken, during loading or storing, to prevent crushing; and on no account must a large accumulation of small coal be allowed. Where possible, the depth of coal in the store should not exceed 6 to 8 feet; and under no conditions must steam-pipes or flues be allowed so near the mass of coal as to give rise to any increase of temperature. These precautions would amply suffice to prevent spontaneous ignition in stored coal on land; while special precautions, which will be found fully discussed in a paper read by me before the Society of Arts,* would have to be taken in the case of coal for shipment.

The lecturer then passed on to consider a very common instance of spontaneous combustion—viz., the ignition of oily waste or greasy cotton rags. He stated that there were plenty of well-authenticated cases in which even a handful of waste which had been used for polishing furniture had ignited when thrown on one side, and had caused disastrous fires. He concluded by saying he had tried to bring forward the important fact that "spontaneous combustion" merely means that the heat due to chemical actions taking place in any substance—heat which has been unable to escape—has raised the temperature to the point of ignition. In speaking of spontaneous combustion, he thought it should be clearly remembered that it represented merely the acceleration of an action which had been going on slowly and surely, although the senses might have been too deadened to detect it; and if we wished to be hypercritical, "unaided ignition" or "natural ignition" would be a far more correct term to apply to it.

Waverley Association of Gas Managers.—The 65th half-yearly meeting of this Association was held at the Station Hotel, Selkirk, on the 14th inst., Mr. G. Taylor, of Jedburgh, the President, in the chair. The Secretary (Mr. J. D. Smith, of Hawick) stated that the funds were in a satisfactory condition. The business was of a conversational character; all present joining in the discussion. At its close, the members and their friends dined together. The next meeting of the Association will take place at Hawick on the second Thursday in April.

New Wenham High-Power Gas-Lamps.—The new price list which is now being issued by the Wenham Company, Limited, testifies to the fact that they are desirous of enhancing the reputation which their high-power ventilating and other lamps have already achieved. The Company have produced three new lamps for the present season, which merit special attention. They are the result of an improved system of manufacture, which enables the Company to place their productions upon the market under exceptionally favourable conditions.

* See JOURNAL, Vol. LIX., p. 488; also Vol. LV., p. 645, and Vol. LVIII., p. 574.

INEXPENSIVE GAS-REGULATORS.

A recent number of the *Bulletin Technologique* of the Arts et Métiers contained an interesting communication on the above subject by M. BANDSEPT, of Brussels, of which the following is a translation.

Of late years, good gas-regulators, simple in construction and of moderate price, have been much sought after. This question has acquired greater importance since the use of high-power lamps has become general; for it has been proved that the variations in the pressure of gas have a more injurious effect on recuperative lighting appliances, the more accurately these are designed with the view to the yield of light, and the smaller their consumption of gas. When high-power burners are not provided with suitable regulators, they often require constant attention. At certain times there is an excess of pressure in the gas-pipes, the consequences of which are easily remedied by a turn of the tap on the lamp. But, though so simple, this precaution is generally neglected; so that it is necessary, in most cases, to employ a regulator acting automatically under the influence of the pressure itself. The commercial problem consists, therefore, in finding, in default of a perfect regulator, an *obturator* valve sufficiently sensitive and constant to ensure the proper working of the lamps and burners, without entailing much increase in the cost of the installation. Many investigations have been made with this view, in connection with both wet and dry regulators. With the former, whether the reaction under the bell or float acts only under the variations of pressure at the inlet or the outlet, or whether the bell is balanced under the general conditions of the supply-pipes, their action would be fairly satisfactory, were it not for the difficulties inherent to the maintenance of hydraulic seals. The liquid or composition employed evaporates or decomposes under the action of the heat radiating from lighting appliances; while other mixtures or solutions do not withstand the cold. These defects may be avoided by removing the regulators from the immediate effects of their surroundings—that is to say, by enclosing them in some non-conducting material, such as a refractory substance, powdered glass, asbestos powder, &c. Or the regulator may be placed as far away as possible from the source of heat, so that conduction along the pipe is reduced. Most installations readily lend themselves to the latter arrangement; but with others the difficulty is overcome by filling the regulators with substances which are solid at the normal temperature, but liquefy under heat—such as stearine protected from the oxidizing action of the air, or glycerine mixed with glue, forming a jelly. Mercury has been tested, and discloses practical inconveniences which can only be remedied by rather expensive devices.

With regard to dry regulators, very few of them have hitherto answered the requirements of the present systems of working. In the form in which it is ordinarily supplied in commerce, the regulator with a moveable obturator demands constant attention, on account of its complicated construction. The variable expansion of its several parts at high temperatures inevitably produces a stoppage in the proper working of the apparatus. When the obstacle to the flow of gas is fixed, the regulator is not so effective as an ordinary tap, as the interposed material is incapable of correcting the variations of pressure.

According to the foregoing remarks, the solution of the problem consists in maintaining the hydraulic seals in liquid regulators, which are the only ones to be relied upon for precision; and there is also the question of expense. With regard to dry regulators, they scarcely give entire satisfaction. Their arrangement is generally defective, on the whole as well as in detail. Valves which are not well balanced, and are lifted by the gas with a jerk—sticking at the sides, and their rods becoming wedged—never give the required sensitiveness to regulators, and their action rapidly deteriorates under the effect of variations of temperature. This result is changed if, in lieu of these defective appliances, an arrangement of clack-valves is employed, carefully balanced, and turning on a small axis, in order to reduce friction to a minimum, and permitting compensative effects with respect to expansion. In this class of apparatus, the hollow body, retaining the most advantageous form for turning in the lathe, presents a slightly conical interior, which produces, during the movement of the palette, an increase or a reduction of the sections intended for the passage of the gas. Some of these regulators act by lamination between fixed and moveable parts; others comprise a supplementary regulation by a screw having a diameter approximately equal to that of the gas passage.

Various types of obturators have been designed on these principles. Their construction is of the simplest character; and they require absolutely no maintenance or repair. Within certain limits, they give satisfaction as regards regulation; and they can therefore be recommended as valuable auxiliaries to high-power lamps.

Fig. 1 and 2 show an arrangement of the most simple type of apparatus of this class. In a conduit T T^1, at the part surrounded by a sleeve M, the ends of the pipes are partially closed by discs R R^1, each having a hole, pierced on opposite sides. The sleeve is divided into two parts by means of a diaphragm S with a hole O in the centre. On the diaphragm is mounted a very light valve P; the part corresponding to the hole O being slightly domed. This valve pivots around the axis D;

and the lateral faces are cut away in such a manner that, in the position indicated by the dotted line, the flow of gas may still take place at the sides, while the incline I limits the flow, and reduces the passage at first left open underneath it. As soon as the gas flowing from T¹ accumulates in the regulator chamber, the valve lifts, and allows a free passage. But this passage narrows as the valve or vane P opens wider, and therefore reduces the orifices almost proportionately to the increase of the initial pressure.

The appliance shown in fig. 1¹ is of the same type as the preceding, but is more carefully constructed. The dome of the valve or vane has a marble which rolls on a slight incline, and entirely or partially closes the diaphragm opening in proportion

Fig. 1.

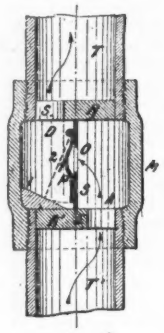


Fig. 1'

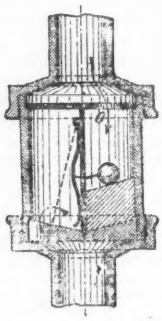


Fig. 3.

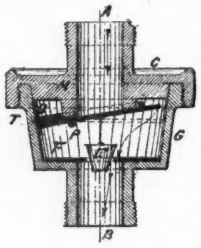


Fig. 2.

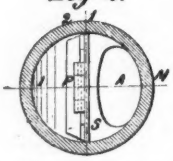
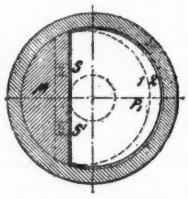


Fig. 4.



as the valve opens under the pressure. Two operations of reducing the gas passages are effected—one by the lateral spaces between the box and the valve; the other, by the closing of the diaphragm itself.

In the regulator shown in figs. 3 and 4, the gas enters at A by the cover C. At P is a hinge, on which turns a disc, to which a cone is suspended, balanced by a weighted body D fixed on the disc The cone closes a circular opening in the diaphragm under the high pressure of the gas; and it thus reduces the central passage. At the same time the conical shape of the box G causes a reduction of flow at the sides when the disc moves. The diaphragm may be removed for alteration of the diameter of the orifice to suit the requirements of local pressure; also the counterpoise counterbalancing the variable pressures of the incoming gas.

Fig. 5.

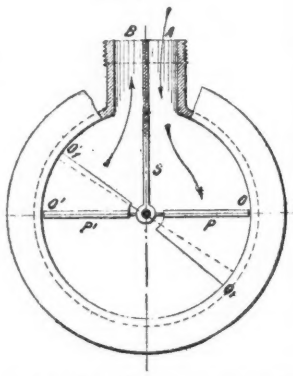
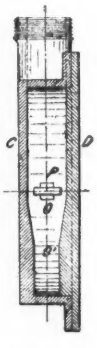


Fig. 6.



The series of appliances commencing at figs. 5 and 6 have a valve oscillating around an axis, with pointed bearings for reducing friction. The box C and its cover D are so arranged that the rectangular space comprised between O and O¹₁ is larger than that extending between O¹ and O₁, which corresponds with the section of the valve vane. From O to O₁, as also from O₁ to O¹, inclines connect the two sizes of space comprised between the interior of the box and its cover. A partition S separates the two compartments for the entrance and the exit of the gas. The valve vane P allows the gas to pass when it is in the horizontal position shown in the drawing. If, however, the pressure at A increases in proportion to that at B, the valve vane enters the conical part O O₁, and the passage is reduced at the inlet and increased at the outlet. This arrangement is very sensitive to variations of pressure; and it regulates sufficiently well in a large number of cases.

Further adaptation to local pressure is furnished by the appliance represented in figs. 5¹ and 6¹. Besides its special merits as a regulator, a feature of the apparatus is its extreme simplicity and facility of construction, as all the parts may be worked on the lathe. The gas enters at A, and meets a fixed stop C at one side, and a valve P P¹, mounted on an axis, at the other side. The difference of pressure between A and B causes the valve P P¹ to leave the fixed stop, and the gas passes from O to O¹, while the foot P¹ of the valve partially obstructs the orifice O¹, acting at the same time as a counterpoise. The regulator includes, in addition, a set-screw for stopping the channel O¹ more or less according to the requirements of local pressure. This apparatus may be placed in any position without affecting its precision of working. A little solder suitably applied on one part of the valve vane will balance it perfectly for any position in which it is required to work.

Fig. 2.

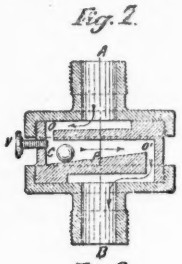


Fig. 5'

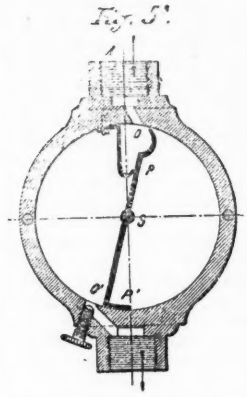


Fig. 6'

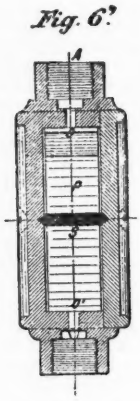
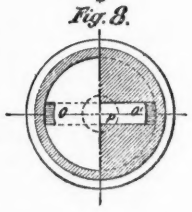


Fig. 8.



In the arrangement shown in figs. 7 and 8, there is no application of the motion of a valve vane around an axis, which may in the course of its working become wedged by certain deposits. The simple rolling of a marble in this case reduces the passage of gas in proportion as the pressure increases. This pressure causes the marble or ball to ascend the incline at a rate corresponding to the force of pressure at the inlet. There is thus an absolute accord between the variations of pressure and those of the flow at the outlet of the regulator. The appliance is composed essentially of a central portion divided into three conduits arranged in zig-zag order by means of parts suitably secured. These passages are large enough for a marble C to be introduced between the two plates; and the central channel narrows to the rear. A regulating-screw F allows of the adjustment of the regulator to work at the normal pressure existing in the place where it is fixed.

Other arrangements, equally simple with those above described, may yet be devised in accordance with the principles set forth, and furnish an "acceptable practical regulation" without being affected by heat or cold. If, after long use, certain deposits should form, and interfere with the working of the appliances, washing with naphtha will suffice to put them in good order again.

In his communication, the author has principally kept in view the problem of furnishing for interior lighting an inexpensive means of obviating the inconveniences resulting from difference of pressure, where a regulator of higher price and duty cannot be applied commercially.

ECONOMY OF FUEL CONSUMPTION IN CARBONIZATION.

At the recent Annual Meeting of the Austro-Hungarian Association of Gas Managers (a brief notice of which appeared in the JOURNAL for July 25 last), Herr H. J. Zubr, of the "Tabor" Gas-Works, Vienna, delivered an address on the economy of fuel resulting from the use of retort-furnaces having a variable air supply. In due course this was published in the official organ of the Association—*Der Gastechniker*—from which the following abstract translation has been made.

A glance at the changes introduced in retort-furnaces points to the great activity displayed in the search for improvements and economies of working; but the particular results achieved by each successive invention cannot be here enumerated. Every gas engineer will, however, admit that there is scope for further reduction, both in the not inconsiderable first cost and in the working expenses of these furnaces; for the fuel used in heating the retorts is the most expensive item in gas manufacture, with the exception of the coal for carbonization. The cardinal principle that a simple furnace, repairable at small cost, is more suitable than a complicated one, admittedly giving as good results, has been recognized throughout the experiments. An endeavour has been made to supply to the furnace exactly the amount of air required at the time for the perfect combustion of the fuel; and loss of heat has everywhere been guarded against as much as possible. The results obtained are encouraging.

The requisite quantity of air varies at different stages during combustion, and the amount admitted should be regulated accordingly; for any excess reduces the temperature of the furnace, while an insufficiency prevents the development of the full heating power of the fuel. In the system here adopted, the supply of secondary air is regulated by means of a hinged flap over the rectangular air-port in the upper door of the furnace. When the furnace is to be fired, the opening of the door automatically lowers the flap; and free ingress of air takes place when the door is closed. The formation of carbonic oxide is greatest immediately after firing; consequently a full supply of air is then needed, and is obtained by the above device. As the development of carbonic oxide diminishes, the air supply is lessened by raising the flap until it partially closes the air-port. The flap is retained in position by a catch protruding from the furnace-door; and when, at a later stage, it is required to entirely shut off the secondary air, the flap is raised until held completely over the air-port by another catch. The times for the partial and complete closing of the air-inlet can be coincident with the drawing and charging of the retorts; so that no extra labour is involved in the manipulation of the air-flap. The supply of primary air is regulated on the same principle by a metal slide on the ash-pan bars.

Furnaces of old patterns can be converted to work on this system at a very small expense; but a diminished arch is desirable. The fuel must never be placed above the lower edge of the upper door of the furnace. It has been found by experiment that the regulation of the supply of air is an advantage with the Coze furnaces with inclined retorts, as well as with the ordinary furnaces for horizontal retorts. The fire-bars should be about 0·8 inch apart; but, with fuel producing much clinker, they may be somewhat farther from one another. According to the nature of the coke, clinkering must take place once or twice in 24 hours. Each furnace has a separate chimney, 44 feet high and 15 inches in diameter, in which a throttle-valve is fixed to shut off the draught during firing, or when on slow fire. The stoker operates this valve by means of a lever; and though it is not an essential part of the system, it is very useful to prevent cooling of the furnace by a current of cold air when the doors are open, with the resulting destruction of the fire-brick lining. For half its height, the chimney is constructed of fire-brick; the upper half consisting of an iron pipe. With the damper open to the extent of about 2 inches, the furnaces work with a draught at the upper sight-hole of about 0·5 mm. only; and consequently, the gases pass away very slowly, and have ample time to impart their heat to the retorts. Prolonged observation proves that the charges can be burnt off better at a bright orange heat than at the white incandescence of other furnaces; while the undiminished yield of gas at the lower temperature is accompanied by several advantages. Leaving out of the question the thickening of the tar in the hydraulic main, which can be overcome by the use of the Drory tar-separator, stopped ascension-pipes and naphthalene deposits in the mains are avoided. The regulation of the secondary air supply keeps the flame from passing up the chimney; and the valve in the latter is unattacked. The supply of secondary air can be regulated empirically, without making analyses of the chimney gases, by observation of the fire through the sight-hole. With careful clinkering, the furnaces should remain undamaged and in good working order for 1200 days.

The following figures indicate the economy attained by the adoption of these furnaces: In a 30 days' trial in which both coal and coke were weighed, and charges of 150 kilogrammes were completely burnt off in four hours, 189,000 kilos. of coal were carbonized by 24,300 kilos. of coke, or 12·85 per cent., as fuel. In 24 hours, each furnace yielded 45 kilos. of clinkers, 30 kilos. of ash, and 75 kilos. of breeze; the latter being again used, and part of the ash doing service under the boilers with forced draught. On the large scale, a works which had previously consumed 22 per cent. of coke as fuel, last year used only 13·75 per cent.—a saving amounting to upwards of 8 per cent. brought about by the adoption of these furnaces. The yield of coke was found to be 6 per cent. higher than formerly; thus making a total saving of 14 per cent. without increased expenditure. The system of variable air supply can be readily applied under all conditions.

North of England Gas Managers' Association.—The next meeting of this Association is to be held at Middlesbrough on the 7th prox., under the presidency of Mr. David Terrace. We learn from the programme of the proceedings which has been issued by the Hon. Secretary (Mr. W. Hardie, of Newcastle) that the President will first conduct the members over the municipal buildings, in the Council Chamber of which they will subsequently be received by the Mayor (Mr. C. L. Bell) and the Chairman of the Gas Committee (Mr. Alderman Hugh Bell), and will transact the business of the meeting. This will comprise the President's Address; a discussion on Mr. Er W. Smith's paper on "Hislop's Regenerative Settings," read at the last meeting of the Association, and given in the JOURNAL for May 9 (p. 823); and a paper by Mr. Herbert Lees, of Hexham, on "Gas Undertakings in Relation to the Use of Gas-Engines." After the business, the members will inspect the inclined retorts at the gas-works; and there will be a steamboat trip on the river.

REGISTER OF PATENTS.

Checking Leakage from Pipes.—May, J., of Penshurst. No. 23,780; Dec. 24, 1892.

To carry out this invention, the patentee proposes to provide a hinged U-shaped piece to receive the leaking pipe. Fitting into it, and over the pipe at the point of leakage, is another similar piece, pressed down upon the break or leak in the pipe by means of screws working into a bar, the ends of which rest in slots provided at each side of one of the pieces. If it is desired, the top of one of the U-shaped pieces is recessed, in order to receive the pressure screw more conveniently; and a flexible sheet or strip of rubber, or such like elastic material, is provided at its edges with metal, so that one of the metal pieces may be dispensed with, as it can be turned up round the pipe—slots being provided in the metal strips, to receive the ends of the bar.

Centre-Valves for Gas-Purifiers.—Hearne, J., and Strong, W. J., of New York. No. 13,487; July 11, 1893.

This invention, relating to "centre seals" used in connection with a plurality of gas-purifiers, has been designed with the object of producing a simple and easily-operated seal, of a capacity to connect with any necessary number of purifiers, and provided with an inlet and outlet arranged in such a manner that the gas may flow unobstructedly through the seal, and which has a plurality of supplemental and easily operated valves, by which the gas may be directed to any desired number of purifiers, or may be cut off from one or all of the purifiers, without interfering with its flow through the seal.

Fig. 1.

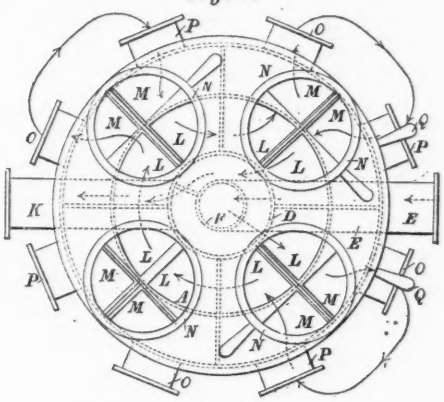


Fig 2.

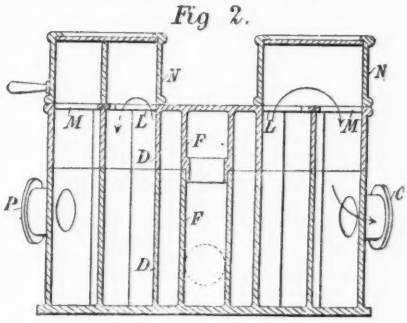


Fig. 3.

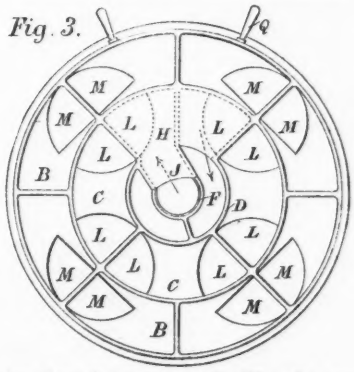


Fig. 1 is a plan view of the centre seal. Fig. 2 is a vertical cross section. Fig. 3 is an inverted plan view of the top cover of the seal.

The seal is provided with a suitable shell, which has a top or cover portion, the interior construction of which is substantially like that of the bottom portion of the seal. This top portion may, however, be turned on the lower portion, so as to bring the purifier-ports into any desired position in relation to the gas inlet and outlet, as hereafter described. The shell is provided with a vertical annular partition, and with a plurality of radial partitions; thus dividing the shell into two series of chambers B C—the series being placed concentric, and the chambers being entirely separated from each other by the partitions. In the centre of the seal is a vertical partition or tube D, which serves as an outlet-tube; and the main gas inlet-pipe E extends inward

through one side of the shell, and terminates in a vertical inlet pipe or tube, which extends up centrally through the outlet-tube F, as shown in fig. 2. The top has partitions placed exactly as in the lower portion of the shell; and when the partitions above and below register, the chambers B C are continuous from the top to the bottom of the seal. The tube F at its upper end—that is, the portion of the tube which is carried by the top or cover—is cut away on one side, as shown at G to provide for the passage of the gas; and two adjacent chambers C of the upper portion of the shell are provided with a transverse partition H at this point. The partition H, as well as the two side partitions, is extended inward, as shown at I in fig. 3, to connect with the side opening in the pipe F, so that the gas which flows in through the pipe will pass into the upper part of one of the chambers C. To provide for the outlet, the plate or partition H is extended across the second chamber C; and this chamber is placed in communication with the outlet-tube D, as shown in fig. 3. The tube F is braced opposite the cut-away portion by a rib extending from the wall of the tube to the wall of the tube D. The chamber C connecting with the outlet-tube is the last chamber through which the gas passes after going through the purifiers; and from this point, it passes downward through the tube D, and out through the outlet-pipe K.

In the top of the seal are holes or ports L M arranged in pairs; the ports L communicating with two adjacent chambers C, and the ports M with two adjacent chambers B. Pivoted on the top of the case above these ports are revoluble supplemental valves N with closed tops; and each valve is provided with a vertical transverse parition adapted to register with a partition, or else lie against the top of the case at right angles to the partition—thus separating the chambers C completely from the chambers B.

It will be seen that, when the partitions register, the gas may flow from one chamber through the valve and into the opposite chamber; but, when the partitions are at right angles to each other, the gas will flow upward from one chamber through the valve N, and back into the next chamber. The valves are each provided with a handle, by which they may be turned; and their position may be determined by the handle and a suitable mark on the seal top. The chambers B are in connection with the gas-purifiers (not shown); and, as illustrated, the seal is adapted to connect with four purifiers, although it may be made of any capacity. The gas under the arrangement shown will therefore flow out from one of the chambers B through an outlet pipe or port O, and back to the next chamber through a port or pipe P, thence through one of the valves N, and so through the next purifier, as will be described presently.

The top is provided with indicators or pointers Q, which project outward, and are spaced so that one will be above a pipe or port O when the other is above the next pipe or port P. One of these indicators is directly opposite the inlet opening or port G; and consequently the position of the indicators or pointers will show the point at which the gas enters the seal, and the first purifier to which the gas naturally flows.

If the gas is to be sent to all the purifiers, the top is adjusted so that the upper and lower portions of the partitions register; and the chambers B C are then continuous from top to bottom. The gas will then flow inward through the pipes E F, pass through the opening or port G, through the port or passage I to the upper part of one of the chambers C; thence up through a port L above the seal top; thence through the adjacent port M to the outer chamber B; thence out through one of the ports or pipes O through the purifier; thence back through the next pipe P to another chamber B; thence up through the opposite side of the valve N; thence back through a port L to the next chamber C; thence through the next valve N and the next pair of pipes O P, and the purifier connected therewith; and so on around the entire seal and the whole series of purifiers, until the gas which passes the last valve N enters above the upper portion of the last chamber C, and from here the gas passes out to the outlet-pipe K.

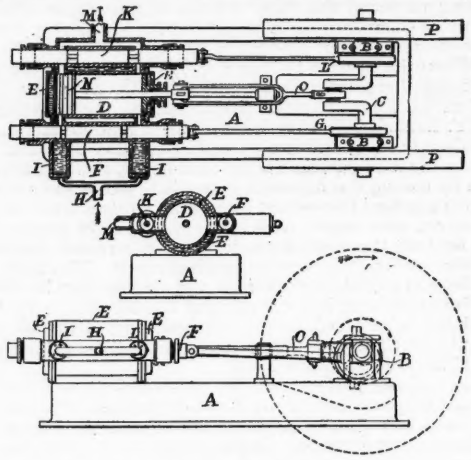
The gas may be shut off from any purifier, by simply turning one of the valves N above the pipes connected with the purifier, so that its partition is at right angles to the partition beneath—as illustrated at A in fig. 1. When this is done, the gas which passes upward into the valve from the chamber C beneath, cannot pass to one of the holes M, but passes through the side of the valve and into the next hole or port L to the adjacent chamber; and so on to the next set of purifiers. In this way, the valves N may be adjusted, if desired, to shut off all the purifiers, and permit a free flow of gas through the seal; or any particular one or more can be shut off.

Applying Combustible Mixtures of Air and Gas or Inflammable Vapour to Driving Motive-Power Engines.—Smethurst, W., Vickers, W. E., and Rogers, G. R., of 39, Victoria Street, Westminster. No. 14,212; July 22, 1893.

This invention relates to apparatus for applying "an intimately and perfectly combined mixture of air with gas or inflammable vapour," to the purpose of actuating motive-power engines of a kind resembling those in which steam is ordinarily used.

In gas-engines or engines worked by the combustion of a mixture of air and gas or inflammable vapour, the patentees remark, it has been usual to form such mixture in, or adjoining, the cylinder in which combustion takes place; the air and gas or vapour being drawn into the cylinder or a chamber by the movement of a piston or plunger contained in the cylinder, and the mixture being compressed by the reverse movement of the piston before being ignited. In such methods of construction and operation, the mixture of the air with the gas or inflammable vapour is said to be "necessarily very imperfect; and the combustion also imperfect, gas being wasted, the products of combustion being difficult to get rid of, and the operation not being economical either in the first cost of the apparatus used or in working."

The mixture of gas and air in suitable proportions is delivered from any adaptable mixing apparatus into a receiver or reservoir, into which it is compressed to a sufficient pressure, which may be varied according to the circumstances in which it is to be used. A pipe from the reservoir conducts the compressed mixture to the valve-box of the engine, as in the accompanying illustration. Here a horizontal engine is shown—A being the bed-plate of the engine; and B, the bearings for the crank-shaft C. The main cylinder is shown at D; its ends being provided with covers E. The supply or inlet pipe H from the reservoir of compressed air and gas, is provided with a regulating-valve (not shown), and with chambers I, containing a sufficient number of wire



gauze or other diaphragms or safety devices, to prevent the possibility of the flame communicating with and igniting the mixture in the reservoir. The admission-valve F in a valve-box or cylinder is actuated by an eccentric or equivalent device in the usual way; but it is so adjusted and operated that, when the piston N commences its stroke in either direction in the cylinder, the compressed mixture is admitted behind it for a short part (say, one-fourth) of the stroke, and is then absolutely cut off by the valve F from the valve-box and inlet-pipe. After the piston has travelled a very short distance further, partly by the momentum of the fly-wheel P, and partly by the expansion of the compressed mixture behind the piston—the mixture is ignited, and the combustion of the mixed air and gas or vapour is rapid and complete—very great power being developed upon the piston by the expansion of the ignited mixture, which pressure continues (with somewhat diminishing force) to the end of the stroke.

An exhaust-valve K (which is shown distinct from the inlet and cut-off valve, and actuated by the eccentric Z) then opens, and allows the escape of the heated and expanded air and gases through the exhaust-pipe M during the return stroke of the piston, during which return stroke a similar series of operations to those above described is taking place at the other end of the cylinder D. The cylinder and covers are provided with a water-jacket E, through which water is made to circulate in the usual way, and asbestos or metallic packing is preferably used where necessary in the engine.

APPLICATIONS FOR LETTERS PATENT.

17,058.—Webb, W. Le P., "Improvements in gas and oil motor engines." Sept. 11.

17,091.—Williams, S. M., Shepard, J. A., "Flash-light burners and charger, and reflector and smoke arrester therefor." Sept. 12.

17,095.—Sheard, J. T., Harrison, S., and Dickinson, G. W., "Gas-meters." Sept. 12.

17,156.—Charlton, T., and Cannon, A. H., "Reducing, regulating, and controlling the pressure of gases or vapours." Sept. 12.

17,247.—Cotton, A. E. and H., "Soldering with gas." Sept. 14.

17,289.—Cowan, W., "Prepayment gas-meters." Sept 14.

17,304.—Smith, R. A., and Marsh, D., "Smoke consumers and draught regulators, applicable to chimneys of fires, gas and lamp burners, and the like." Sept. 14.

17,314.—Dobbs, A. E., "Water-meters." Sept. 14.

17,345.—Gadd, W., "Ladder for gasholders." Sept. 15.

Extensive Sewage Works for Oldham.—Yesterday week, the Mayor of Oldham (Mr. Alderman Noton) cut the first sod for new sewage works for the borough, which are to be constructed at a cost of about £200,000. The Corporation are themselves, without the aid of contractors, undertaking the work.

The Defective Reservoir Embankment at Heywood.—The Heywood Town Council have adopted the report of the Water Committee on the contemplated construction of a concrete retaining wall on the outside of the Naden higher reservoir embankment, to which allusion was made in these columns on the 5th inst. The Borough Engineer (Mr. J. Diggle) has been instructed to prepare the requisite plans and estimates; and these will be submitted at an early meeting of the Water Committee, to which the whole of the members of the Council will be invited.

Contracting for the Water Supply of Sacramento.—Some peculiar specifications for supplying water to Sacramento (Cal.) are, says the *Engineering Record*, under discussion in that city. The water is to be taken from wells at least half a mile from the present city limits, and the same distance from any natural surface stream or pond. The contractor is required to guarantee "clear, sweet, and wholesome water suitable for drinking water and domestic purposes." A minimum of 1000 million gallons a year is to be supplied in such daily quantities, not exceeding 8 million gallons, as may be required. At the end of five years, this minimum may be increased by the city on giving six months' notice. The water is to be delivered through a riveted steel or iron pipe laid and owned by the contractor, and delivered through a meter. The contractor must not furnish water direct to the customers, and is to have no control whatever over the mains, distributing-pipes, or water-rates, which are to be entirely in the hands of the city authorities.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by our correspondents.]

Gas-Fires.

SIR,—Your correspondent, "M.D., Lond.," has re-invented an appliance which has been "re-invented" a great many times during the last thirty years. The arrangement for closing the air supply by the motion of the gas-tap must be quite familiar to the older generation of users of atmospheric burners. It has never found favour in practice, and has been repeatedly discarded, to be re-invented at various intervals. Quite recently I had offered to me an invention of this kind, which was absolutely identical with a burner which had been familiar to me for at least twenty years, and was at the time in my possession.

The sliding air-cover for fire burners has two serious objections, which have prevented the application of it in practice. The first is, that the tap must of necessity be close to the air-inlet, to prevent complication of parts. This is a most objectionable position for any tap. The second is that, with the majority of users, it is totally unnecessary, as, when a fire burner is turned so low as to be in danger of lighting back, it becomes most extravagant, and, as a rule, useless for any practical purpose. Radiant heat obtained from a burner working at a low point, and consequently at a low temperature, is a very costly luxury indeed, especially with the class of ball fires which are now so largely used. With a thin vertical incandescent surface—such as that of the original form of fibrous asbestos fires—a moderately good result can be obtained from a burner turned to a very low point. But the best burners used for this class of fire admit of being turned down to a very small flame, without any risk of lighting back. Hence their special value for bedroom fires, although the duty obtained, *at full power*, is appreciably less than that of other forms more recently introduced. For ball and iron fires, a system of divided burners, which can be used in separate sections, was introduced some years ago; but this has not become at all general or popular—probably owing to the increased expense and complication.

So far as the invention of your correspondent "M. D." is concerned, he may rest assured that it is ancient—it is, in fact, one of the oldest of the many forms of atmospheric burners, and certainly not worth the expense of any more patents. If it did not introduce other practical objections quite as great as those it is supposed to remove, its use would have been general many years ago.

With regard to the smell of acetylene, &c., caused by a burner lighted back at the jet, your correspondent appears to be one of a singularly numerous class, who expect a gas-fire to cure a smoky chimney. In the absence of a down draught, there is no smell whatever in the room, whether the burner is lighted back or not; and, if a down draught exists, the use of any incandescent gas-fire is equally objectionable, whether lighted back or not. As to noise, nearly, if not quite, all the noise is originated in the gas-*tap*, not in the burner; and if a good governor is used, working at about 8-10ths pressure, the sound practically disappears, unless the tap is an exceptionally noisy one.

Warrington, Sept. 21, 1893. THOS. FLETCHER.

The Artesian Well at Gainsborough.—The Water Committee reported to the Gainsborough Local Board yesterday week that the town was now being supplied with artesian well water, and that the temporary pumps could not exhaust the quantity. They were now obtaining about 540,000 gallons a day, and did not require 500,000 gallons, so that they had an ample supply. They wished the Local Government Board to hold an inquiry respecting the application to borrow £12,000 for the purpose of making the works permanent.

Filey Water and Gas Company.—In addressing the shareholders at the recent meeting of this Company, the Chairman (Mr. J. Pirie) stated that the business in both departments had been fairly satisfactory during the past year, although the receipts had been somewhat curtailed owing to a reduction in the price of gas. The revenue, however, continued to increase. In 1891, the amount received for gas was £1660; and for water, £803. The figures for 1892 were £1701 and £973 respectively; and for 1893, £1760 and £919. The Directors' report having been adopted, dividends of 6 per cent. on the original shares and £4 4s. on the new shares were declared.

Harrow District Gas Company.—The ordinary meeting of this Company was held yesterday. The Directors reported that, owing to the fineness of the weather during the past half year, the consumption of gas has been slightly less than in the corresponding period of 1892; but there had been some improvement in the value of residuals. The amount received for gas (including £144 for meter and stove rental) was £3929; and the bye-products realized £655—the total revenue being £4585. The expenditure totalled to £2928; thus leaving a profit of £1657. The balance on the profit and loss account was £1745, out of which it was agreed to pay dividends at the rates per annum of 7½, 7, and 5¼ per cent. on the various classes of capital.

The Electric Lighting Scheme for Salford.—A Local Government Board inquiry was held at Salford last Tuesday, respecting an application by the Corporation for authority to borrow £50,000 for the purpose of electric lighting. The Town Clerk (Mr, Samuel Brown) explained that the Corporation were empowered by their Provisional Order of 1890 to supply the electric light within the borough, and to secure land and do other matters incidental to such supply. They had accordingly secured a piece of land, some 7600 square yards in extent, for £2774. It was not proposed to proceed with the entire scheme at once; but it was intended to expend only £32,000 of the £50,000 applied for in the initial operations. The scheme affected the entire borough; and it was anticipated that it could be carried into effect within six months of the date on which sanction was given. With regard to the repayment of the loans, they asked that it might be spread over a period of 30 years. Mr. E. Manville, M.Inst.C.E., Electrical Engineer to the Corporation, gave evidence as to the details of the scheme; and the Inspector afterwards visited the site of the station.

MISCELLANEOUS NEWS.

A PROJECTED COAL TRUST.

[From *The Times*, Sept. 20.]

Next after water and bread, coal is recognized to be the most genera necessity of English life. To waste it is to waste the tissues of our strength; to economize the production and to prolong the duration of the supply is proportionately to prolong the period during which we may hope to hold a first place among the nations. It is no exaggeration, therefore, to say that there can hardly be a proposal of greater importance to consider than one which would materially affect our manner of dealing with this vast possession. Such a proposal is contained in a scheme for the consolidation and common working of all the coal interests of the United Kingdom, which, after years of consideration and consultation between coal experts and other eminent authorities, it has been decided to lay before the public. The name of Sir George Elliot, who is the proposer and originator of the scheme, is too well known to call for comment. There is perhaps no one in Great Britain who is better qualified by practical experience to take the position of leader in the movement which he has initiated. He claims that the object of the great change which his scheme seeks to compass is in no way the creation of a monopoly or trust for the sole benefit of the proprietors, but a combination which shall be a benefit not only to the coalowners, lessees, workmen, and consumers, but to the nation at large. It is on this level that the scheme challenges consideration; and, in so far as it makes good its right to this high ground, it ranks for judgment among the great political commercial conceptions of the day. The very interesting difference which exists between such a proposal and the proposals of the chartered companies, in which the public have also been asked to recognize other than purely financial aims, is that, while the schemes of the chartered companies have dealt mainly with the expansion of the Empire abroad, this scheme follows the other leading current of political life, and associates itself directly with the development of social questions at home. It is the first time that a commercial scheme of any magnitude has attempted to do this. It differs also from the chartered companies in the fact that it requires no political sanction for its formation. The co-operation which it needs for success is in the first instance solely the co-operation of the coal lessees of the United Kingdom, who are invited to exchange their interest in the properties at present worked by them for shares and debentures in a united coal company. The company shall then undertake the working of the entire coal deposit of the country, with all the attendant responsibilities involved by the employment of so vast a body of labour, and the sole command of the home supply of fuel. The scheme works out in ably-devised detail the conditions under which it is proposed that such an amalgamation of competing interests should be accomplished.

The present yearly output of the coal-fields of Great Britain is 182,000,000 tons, which, at an average selling price of 7s. 3d. a ton, represents a gross value to the coalowners and lessees of £65,975,000 per annum. From this, £54,600,000 must be deducted to cover the average cost price of 6s. per ton at the pit bank. The remaining £11,375,000 represents roughly the profits which may be made under the present system of working by the coal lessees. About 20 per cent. of the quantity of coal now produced is consumed in the working of ironstone and in the manufacture of iron and steel. As a great deal of this is raised and worked by the ironmasters themselves, who would evidently have nothing to gain in joining a scheme based on any general principle of profit-making, it has been left out of consideration; and the calculation is based on a present annual output of 145,000,000 tons. It is estimated that the sum required to represent the whole capitalized interest of the lessees would be slightly under £110,000,000. This figure does not greatly exceed the share value of the London and North-Western or even of the Midland Railway; and, in view of the fact that the amalgamated value of the railways of Great Britain would come to nearly £900,000,000, it will probably be a matter of surprise to many people to learn that the capitalized value of the amalgamated coal-fields would be so relatively small. The capital sum to be dealt with, although considerable, is not therefore of such unmanageable magnitude as the first thought of a consolidation of the coal interests of the United Kingdom would suggest. The basis of co-operation on which it is proposed to carry out the scheme dispenses with the necessity to raise any greater portion of this sum in cash than may be required to free the collieries from present obligations. For this purpose it is proposed, probably with some foreknowledge of the chances of carrying out such a proposal with success, that a body of bankers shall be formed who shall agree to take debentures, at a price to be agreed upon, from any colliery proprietor, to an amount not exceeding one-third of those allotted to him. It is a further detail of this proposal that anyone so applying for the exchange of his debentures into cash should set aside an equal amount of his shares, giving to the bankers an option for twelve months to take the same at par. The total amount of cash required will not, it has been estimated, be likely to exceed the provision thus made for it.

The figures disclose nothing impracticable in this part of the scheme. The question of its working feasibility turns mainly upon the advantages which the coal lessees might hope to gain in return for their co-operation. Many of these advantages are obvious. In the first place, as a united body owning the whole coal wealth in the country, they would (paradoxical as the statement may at first sight seem) have a larger mass of available coal in their possession than any added computation of their individual properties would now give. A lessee under existing conditions is obliged to leave on the boundary of his royalty a solid rib of coal varying in width from 40 to 100 yards, which is a total loss alike to himself and to the nation. A consolidation of royalties, doing away with the necessity of boundaries for any but engineering purposes, would bring nearly the whole of this coal into the market, and, together with the facilities which a different method of working would give for the hauling of small coal now allowed to

go to waste, would, it has been estimated, add fully 10 per cent. to the annual output. This would mean, if all other conditions remain as they are, an increase of 10 per cent. upon the existing collective profits of the coal trade. But the saving in coal itself is only one of the economies which the substitution of co-operation for the present system of competitive development might be expected to introduce. The expenses of pumping, ventilation, and underground haulage are amongst the most considerable items of cost in the process of raising coal. All of these might, it is claimed, be much reduced if the area to be treated were regarded only in the light of the physical peculiarities, and dealt with without consideration of arbitrary divisions. Pumping power, instead of being distributed as now, would then be concentrated in the most advantageous points to deal with water at its source, and thus avoid the disastrous deep-level floodings which are so frequent a cause of waste and expense. The ventilation of large areas unimpeded by artificial obstructions would be safer and more economical than the present system, under which the coal-beds are honeycombed with separate mines, and ventilated, as it were, in every cell. The saving in underground haulage alone which would be effected by the abolition of eccentric surface boundaries would be considerable. With the existing system, coal may have to be hauled for distances of as much as two miles from the pit bottom, owing simply to the irregular configuration of an estate; while coal from the very same bed is being taken up by a neighbouring colliery, on a different estate, within a few hundred yards. The enormous expense which this long underground transit entails in keeping the passage-ways open and timbered, merely for lack of a more convenient right of way over the neighbouring ground, illustrates vividly the waste and friction, now unavoidable, which under a system of united ownership would disappear.

Briefly, the effect of amalgamation, it is contended, would be to remove all the artificial factors which now stand for so much in the sum of the coal-mining industry, and to leave Science and Nature face to face. The different coal districts would then be treated each as a whole, according to its geological peculiarities. Under a more fully organized method of working, the whole of the coal, good and bad, could be systematically extracted, instead of being, as now, largely wasted for the sake of bringing up only those kinds which produce the highest market prices. Beyond this, it is anticipated that there would be an additional and important saving in the cost of distribution, as each group of collieries, having no longer an individual interest in seeking distant custom, would naturally supply that part of the country in which its coal could be most easily delivered.

The more the scheme is considered, the less doubtful does it appear that the value of the coal property of the country as a whole would be increased by its adoption. The value of the whole being greater, it seems to follow as a mathematical deduction that the value of the parts must be proportionately increased; and the existing coalowners and lessees must gain by accepting the share which is proposed to them in the general scheme. There remain, however, two very important points for their consideration; and these are fully dealt with in the scheme. One is the management of the proposed new system; the other, the still more delicate and knotty question of the appraisement of the value of existing properties, together with the manner in which the profits of the proposed association should be shared.

With regard to management, it is proposed to create a central representative council; the unit of representation being a given number of tons of coal. Thus the several coal districts of England, Scotland, and Wales would be entitled, for every average annual output of 5,000,000 tons, or any other quantity that may be fixed, to elect a representative upon the central council, which will be charged with the general management, supervision, and control of the business of the company. Under this central council, it is proposed to create about thirty district committees, which would be immediately concerned with the working of the collieries and local business of their respective districts. These committees would also be elective, and would consist of representatives chosen in a fixed proportion by the shareholders and the miners, Existing managers and factors would continue, in the majority of cases, to be employed; and when that is impossible, it is proposed to give liberal compensation. But the district committee would absorb and take over the duties of numerous existing boards of directors, and thus cause considerable ultimate saving in management expenses.

The appraisement of existing values in coal properties has been looked upon as in some respects one of the most practical of the difficulties to be met. It has, however, to be borne in mind that such appraisement is at the present time constantly made for purposes of sale or for division rendered necessary by the death of a colliery proprietor. The principle of procedure would not be new—it would only need application on an extended scale; and, in order to secure the greatest possible impartiality in the carrying out of so large an operation, it is proposed to place the appraisement of values in the hands of bodies of experts nominated by the colliery proprietors for approval by a central council. These bodies of experts would take evidence and make all investigations which might be found necessary in order to arrive at an equitable estimate of the value of each property. Further, it is proposed, as a guide for their deliberations, that a sum of about 15s. per ton for coal of ordinary quality, calculated on the average annual output of the last few years, should be taken as the level from which differing values should be approximately determined. Many collieries will be found to be worth more than this; others again, will be worth less; and there are various exceptional conditions which it will be the duty of the boards of experts to take into consideration. But it is believed that a fair estimate of annual output, calculated at 15s. a ton, will be found to represent the capital value of the entire coal beds of the United Kingdom. Should this calculation prove to be mistaken, it is not a matter of vital importance to the scheme; for, as the collieries themselves will represent the bulk of the united capital, and the owners will claim profits only in proportion to the capital value of their shares, it will matter little, so long as the appraisement is relatively just, what figure the sum of the united value may reach.

This brief outline serves to indicate the nature of the advantages which the colliery proprietors might expect to draw from an amalgamation of their interests. Such advantages have already been enjoyed in other countries by the American system of combination; and, if a combination in coal were all that Sir George Elliot's scheme proposes to effect, it would be travelling over common ground. But the scheme does not stop here; it is of wider scope. The labour which is directly employed upon the coal properties of Great Britain amounts to something not far short of a million of men. The interests of a million human beings, who, with the wives and families dependent upon them, may be estimated to form nearly an eighth part of the population of the kingdom, have a weight and importance which the dislocation of industry that has followed upon successive strikes does not allow any of us to forget. Sir George Elliot has studied the coal industry on every essential side. He has a right to speak with authority upon the needs, the aspirations, and the fair requirements of the great body of English miners; and it is from the point of view of the enlightened pitman that the proposals which affect the workman's share in the new scheme have been conceived. They are put forward with a confident assurance that their adoption will relegate strikes to a closed chapter in the history of the coal trade. The guiding principle appears to have been the same as that which prompted the application of the system of local self-government throughout our political organization. The men are to be made, as far as possible, responsible for their own affairs. In the first place, it is proposed that the question of wages should be determined by the district committees, on which it is to be remembered that the miners are represented by their elected directors; and these committees shall be empowered to deal with the special features of each mine, so as to obtain, as far as possible, an approximately uniform scale of wage throughout the country. It is laid down as an axiom that the scale shall be calculated on a liberal basis as compared with other classes of labour. The general employment of the best appliances, which will become possible under one responsible system of management, and the added facilities for pumping and ventilation, will, it is estimated, greatly ameliorate the average conditions under which work is carried on, and lessen the existing risks to life. It is claimed that this uniformity in wages and conditions of labour must in itself remove the cause of many partial and local strikes. Among ameliorating measures, it is also proposed to establish a general insurance fund for worn-out and disabled workmen and their families. The amount of the insurance fund may be fixed by a subsequent decision of the central board; but it is suggested that 1d. per ton upon the entire present output would provide for this purpose a sum of £758,333 a year.

But these proposals are only nibbles at the great principle of admitting the claims of labour to share with capital in the profit-earning power of industrial enterprise. The principle is accepted wholly in a clause of the scheme which includes a certain limited interest upon capital as part of the working expenses, and provides that the workmen shall share equally with the coal lessees in any further profit that is made. Nothing in the scheme is more interesting and novel than the section which deals with the division of profits. From what has been already said, it will have become evident that the interests of the labour employed in the mines have been no less practically safeguarded than the interests of the landlords and the coal lessees. But of late we have heard of proposals put forward that the men and masters should enter into combination to raise the price of coal, and thus satisfy their own requirements at the public expense. Such an amalgamation of coal interests as that contemplated in the present scheme would offer a field of rare opportunity for unscrupulous action of the kind, and there could be little question of enlisting public sympathy in its accomplishment, unless the strongest guarantees were given against any such possible abuse of the position. Sir George Elliot appears to have appreciated this aspect of the question, and accepts all the obligations of the high ground he has taken. He offers to secure for the men and masters every advantage which some of them have imagined they might gain from the simple process of allowing wages to govern price; but he proposes to get out of the increased volume and better working of the available coal supply what the authors of so impossible a combination propose to take out of the public purse. In doing this, he claims that a substantial benefit will be conferred upon the nation at large; but it is not merely by the additional value which will be given to an important article of primary production that he seeks to justify the public utility of his project. The interests of the public are most directly safeguarded by a clause which admits the consumer to immediate participation in the benefits of the economy which is contemplated. The scheme accepts in its entirety the principle of the limitation of interest; and one of its essential conditions is the provision that the price of coal shall never be raised above the figure which is required to give an interest of 5 per cent. upon the debentures, and to reach a maximum of 15 per cent. upon the stock, without the sanction of the Board of Trade. It has been estimated that an average selling price at the pit bank of 7s. 3d. per ton, at the present annual rate of output, would suffice to give the interest required. The purchaser, it is claimed, would thus be protected from the possibility of extortionate prices in the future; and, in order to give full effect to this guarantee, it is proposed to invest the Board of Trade, either in the Articles of Association of the company or, if necessary, with parliamentary sanction, with all functions essential to the exercise of its arbitrating powers. More than this, it is provided that, in the event of the Board of Trade sanctioning an increase of dividend beyond 15 per cent., the purchaser shall receive in the form of discount, a share equal to that of the labourer and the lessee in the profit made. It is also believed that a considerable benefit will accrue to the poorer part of the population by the power which will be acquired of working coal hitherto wasted, and distributing it at a low price to the consumer. It is a matter of common knowledge that the poor, who cannot afford to store coal in the cheap season, at present pay a considerably higher price, in proportion to their consumption, than the rich. The distribution of water at equal rates to poor and rich proved to be only a matter of organization when water supply was dealt with on a large scale. The details of the manner in which the principle is to be applied to coal have not been fully worked out; but it is believed that, when there is but one salesman for coal throughout the country, and the prices of that salesman are regulated by a decision of the Board of Trade, the fluctuations of retail price must be greatly

checked, and the creation of agencies of distribution where coal could be obtained at a fixed published rate would be, like the distribution of water, a mere question of subsequent organization.

The scheme thus becomes a three-sided one, in which the lessee, the labourer, and the public are invited to amalgamate their interests. Treating coal as an article of general utility, the production of which is too important to be left to the hap-hazard incidence of the competitive market, it proposes nothing less than at the same time to reform the method of supply and to regulate the price of consumption. It is to this two-edged nature that the scheme owes the unique quality of the interest which it arouses. The whole appears to have been thought out on a strictly utilitarian basis. No one interest is allowed to override the others; but it is sought to demonstrate that the advantage of each is co-ordinate with the profit of all.

The definite proposal which the scheme embodies may be summed up in set terms as follows: The coal lessees of the United Kingdom shall amalgamate their existing interest in a co-operative company, charged with the entire working of the coal deposit of the country; taking payment in the form of one-third debentures and two-thirds stock—all stock to be interminable. A reserve fund shall be formed for opening further collieries to take the place of those annually exhausted, and to provide for extensions and sinkings. An insurance fund for workmen shall be set aside; and a sinking fund for the redemption of capital shall also provide the means for rendering the consolidated property permanent. All further earnings will be applied, first, in paying interest on the debentures at 5 per cent.; secondly, in paying a minimum dividend of 10 per cent. upon the stock. In view of the exceptional nature of the property concerned, it is believed that the dividend upon the stock need never be less than 10 per cent. But the profits shall not exceed 5 per cent. more without the approval of the Board of Trade; and such 5 per cent., if paid, shall be divided equally between the lessee and the workman. In the event of the Board of Trade sanctioning an advance in price sufficient to yield any interest beyond 15 per cent., the whole further profit will then be divided equally in thirds between the workmen, the coal lessees, and the purchaser. As in such an arrangement the purchaser pays the whole difference, and only receives back a third in the form of discount, the interest of the workmen and the coal lessees will manifestly be to bring pressure to bear upon the Board of Trade to sanction an advance in price. The interest of the public will be to bring pressure to resist an advance. Between these two fires, the Board of Trade is called upon, by the terms of the scheme, to protect the several interests of all parties concerned. If, on consideration, it should be found that the political composition of the Board of Trade would render it inexpedient in the public interest to invest it with ultimate powers of control, it is proposed to substitute referees, who shall be appointed by high judicial authority—say, the Lord Chief Justice. The principle of limiting the interest on capital is, it is submitted, one that has long been recognized in this country in the supply of gas and water; and there need be no difficulty in the application of the same principle to coal.

If the calculations on which this proposal is based are correct, the coalowners, it is believed, would gain a security for their dividend which would be scarcely less than that of Government stocks; the public would gain the advantage of a steady, moderate price, which would be safeguarded from the fluctuations caused by strikes and other accidental circumstances, and would not be altered without the sanction of the Government; the workmen would gain better conditions of labour, better wages, and a share in the profits; and the nation would gain in the more economical, and at the same time more thorough and systematic, development of the coal deposits.

All this is a great deal to promise; and to submit proposals for a scheme of this magnitude is manifestly a very different thing from carrying it to a successful issue. The first and most practical question for consideration is whether the coal lessees of Great Britain will be disposed, as a body, to consider that they serve their own interests by exchanging their present chances of a higher rate of profit for the practical certainty of 10 per cent. which the new scheme claims to offer. A majority of two-thirds of the coal lessees of the country would be required in order to ensure the success of the working of the scheme. Many of them have already been consulted; and, as it is believed that one effect of the better security would be to increase the capital value of coal property from the present figure of five or seven years' purchase to something like twenty years' purchase, little doubt is entertained that the requisite number would be found willing to join the enterprise. The amount of existing obligations (mortgages, &c.) to which coal properties may be subject is also, by the necessarily private nature of many such obligations, difficult to estimate beforehand. It is believed by the supporters of the scheme that the readiness with which debentures could be disposed of would meet all requirements likely to arise on this head; and it is, in general terms, presumable that an increase in the security of a property can hardly be regarded as an injury to the interests of a mortgagee. But in its financial aspect, the scheme must be regarded as an immense conversion scheme; and experience with the conversion of many public debts has shown that arguments in general terms are not always received as absolutely satisfactory in individual application. For all these reasons, it is clear that many obstacles remain to be disposed of before it can become possible for the proposals embodied in the scheme to be carried into effect. Should these be removed, and the full practicability of the measure be established, it will still be for the various parties involved to watch with care over the maintenance of the economic theory of the balance of interests upon which it takes its stand. Without attempting to predict its fate, it may be safely said that the conception and publication of the scheme will, in any case, have submitted for consideration one of the most interesting possibilities of industrial development witnessed in this generation.

Electric Lighting at Brighton.—Last Saturday week a considerable portion of the Front at Brighton was lighted by electricity for the first time. Forty lamps are employed; and twenty are put out nightly at eleven o'clock—the others being kept on till dawn. The difference in the cost, as compared with gas, is an annual increase of £300.

OTTOMAN GAS COMPANY, LIMITED.

The Half-Yearly Meeting of this Company was held last Tuesday, at the London Offices, 9, Queen Street Place, E.C.—Mr. EDWARD HORNER in the chair.

Mr. T. GUYATT (in the absence of the Secretary, Mr. A. J. King read the notice convening the meeting; and the report and accounts, to which reference was made in the JOURNAL for the 12th inst., were submitted.

The CHAIRMAN said that on the present occasion there was really not very much for him to say; and the few remarks he had to make were nearly all in favour of the Company. In reference to the variations in the principal figures, it would be seen that the item of coals (£2734) was £29 less; and, most fortunately, the residual products had yielded £1682, or £258 more. The only item on the receipt side of the revenue account in which there was a slight diminution was the gas-rental; but it only amounted to £51. This was caused entirely by the Municipality having the public lamps alight for a shorter time; so that they consumed less gas. There was another matter which had affected them in common with a great number of companies carrying on business in foreign countries—that was exchange, which had amounted in the past half year to £663, as against £578; but, of course, it was quite outside the power of any Board of Directors to prevent this. He moved that the report and accounts be adopted.

Mr. A. J. DOVE seconded the motion, which was carried.

On the proposition of the CHAIRMAN, seconded by Mr. DOVE, a dividend at the rate of 7 per cent. per annum (free of income-tax) was declared on both classes of shares.

A vote of thanks was then passed to the Consulting Engineer (Mr. H. W. Andrews), the Engineer and Manager (Mr. John Gandon), the Secretary, and the staff; and a similar compliment was afterwards paid to the Directors.

These votes were suitably acknowledged by the CHAIRMAN, and by Mr. ANDREWS, on behalf of the officials and staff.

THE CRISIS IN THE COAL TRADE.

The struggle between the Coalowners' and Miners' Federations was not brought to a close during the past week, although the end seemed to be in sight. The principal events are briefly recorded below.

The opening of the week found the strike at Whitehaven at an end, and the miners in the Darwen district and at Hoddlesden resuming work at the old rate of wages. The Forest of Dean miners, to the number of about 5000, also returned to work; and in Derbyshire, some of the men who had not received notice of a reduction, but were called out by the Federation, did likewise. Expressions were heard at various pits that the miners were heartily sick of the struggle; but the men were unwilling to go in while the great bulk of their fellows were unsettled. At Barnsley there was a strong feeling in favour of resuming work at the collieries where the old rate was offered. At a mass meeting of miners held at Normanton, speeches were delivered by Mr. Keir Hardie, Mr. Cuninghame Graham, and Mr. J. Lister, of Halifax, denouncing the Government for sending troops into Yorkshire to fight the coalowners' battle, and urging the men to organize and support the independent Labour party, as neither Liberal nor Conservative would do justice to the miners' interests. A resolution was passed condemning the shooting of the men, and asking the Government for a parliamentary inquiry. At a meeting of the delegates of the North Staffordshire Miners' Federation, held at Burslem, Mr. Enoch Edwards was instructed to communicate with the coalowners of the district, requesting them to refrain from sending coal into Lancashire and Cheshire during the strike. While careful to avoid dictating to the coalowners in any sense, the delegates felt they had a claim on them, not to provoke any misunderstanding with the North Staffordshire men by exasperating the miners of Lancashire and Cheshire. The delegates stated that the owners could sell all their coal in other districts. Several firms in the Pelsall district agreed to reopen their pits, and take back their men at the old rate of wages, pending a general settlement by the Federation, but subject to a fortnight's notice on either side. These firms did not give the general notice for the reduction of 25 per cent. with the other employers; but their men were subsequently called out by the Federation against the wish of the agent, Mr. Dean.

Mr. Johnson, the Warwickshire miners' agent, announced that he was prepared to ignore the Federation, and to allow any of his men who could do so to resume work at the old rate of wages. In accordance with the decision adopted by the Pelsall miners on the previous Friday, a meeting was held at Walsall between masters and men, when the following arrangements for the resumption of work in the Pelsall district were come to: "(1) The old rate of wages to be paid; (2) the general settlement of the Federation to be approved on the next pay-day after such settlement has taken place, but not to affect the current week or fortnight as the case may be; (3) if the men resume work, they work on the usual terms of 14 days' notice on either side." The conditions were to be submitted to a mass meeting of men; and, if they were accepted, work was to be resumed.

In accordance with the arrangement recorded above, a mass meeting of miners took place on Tuesday, at Pelsall, to consider the proposal to resume work at the old rate of wages. About 5000 persons were present. The Chairman (the Rev. H. Roe) congratulated and thanked the agent (Mr. Dean) for bringing forward the proposition they had met to consider. Mr. Dean, who was received with great cordiality, regretted that they were not there to rejoice over a general instead of a partial settlement in their own district only. He had heard that there was an opposition movement afoot in certain directions, based on the hope that the proprietors could make better terms with their own men than those settled at the meeting on the previous day; and that the men might be induced to return to work at 10 per cent. reduction. He defended the agreement which had been come to as the best possible. Everything within their power

should be done to bring the struggle to a successful issue. In explanation of the second clause, he said that, in the event of a general settlement by the Federation, it would not affect the Pelsall men's pay at the next reckoning, but would come into operation at the following pay-day. A resolution approving the agreement was carried, with 39 dissentiants. In the Chesterfield district, the men viewed with favour a proposal to meet the employers; and it was generally believed that the miners' leaders would be powerless to prevent the men returning to work. The position will be seen from the following extract from a Dalziel telegram, dated the 19th inst.: "A week ago, the leaders were loud in protestations of resistance; but several of them to-day express the opinion that a settlement should be come to. The clear statement that the deduction proposed is not 25 per cent., but 25 of 40 per cent. granted since 1881, has done much to clear the air. Wages were advanced 10 per cent. in 1882 and 1883. In 1884 they were again advanced; and there were advances in all amounting to 40 per cent. until 1890. Thus £100 paid in 1881 reached, by accumulative advances, £161 8s. 2d. It is now proposed to put the scale back to 1889, when it stood at £127 1s." The sender of the telegram added: "I have made inquiries, and believe that a settlement will be come to by the men accepting a 15 per cent. reduction. The London coal porters, in answer to a request of the Miners' Federation, have refused to strike, as they say that, on account of the quantity of unskilled labour, a strike would be useless. It is believed in mining circles that the strike will be over by the end of next week." Something like 5000 miners attended a meeting held at Barnsley, under the auspices of the Yorkshire Miner's Association—Mr. Cowen presiding. Owing to illness, Mr. Pickard, M.P., was unable to be present. Mr. Cowen, referring at some length to the present aspect of affairs in the country, said it was monstrous for the coalowners to suppose that the miners of this country were going to accept a reduction of 25 per cent. on what was now barely a living wage. Come what might, they would never submit to the reduction, although the owners called to their aid the most cruel of all weapons—that of starvation. He spoke very strongly on the course taken by the authorities in bringing the large force of military into the district. Mr. Parrott, in moving a resolution endorsing the course of the miners' representatives at the Nottingham conference, and asking the owners to allow the men to resume work at the old rate of wages, said that doubtless the 20th rule of the Miners' Federation of Great Britain had failed, but that this was owing to the traitorous conduct of the Northumberland and Durham men, who had not remained faithful to the Federation. Although the ballot was against them, it would, he thought, be to their common interest to resume work where the owners were willing that it should be done at the old rate of pay. With respect to the demand for the reduction of 25 per cent., he would inform the owners that the men were still as firm as they were on the 28th of July. Come what might, they would never submit to it. The resolution was passed, as were also others calling for an inquiry by the Government into the step taken by the authorities in calling out the military at Featherstone. The effect of the strike was shown to-day in the price of coal in Manchester, which had in two days risen 3s. 4d. per ton; making a total advance of 7s. 6d. per ton since the stoppage.

On Wednesday there was a faint indication of the protracted struggle being brought to an end. Addressing a meeting of 3000 miners at Downall, near Wigan, Mr. S. Woods, M.P., stated that it was just possible a joint meeting of employers and representatives of the men would be held at the end of the week, and some suggestion submitted that would tide over the difficulty, and allow the men to resume work. A resolution protesting against any reduction of wages, but at the same time recognizing the efforts being made to bring the crisis to a close was carried. An important statement was made, but not at this meeting, by Mr. T. Ashton, Secretary of the Miners' Federation. According to him there is a rooted dislike to arbitration on the men's side, whatever may be the case with the employers. Past arbitrations, the miners hold, have, so far as they are concerned, invariably proved unsatisfactory; the selling price of coal being the sole basis on which awards are made. They rather favour profits as the regulation medium; but, whether selling prices or profits are accepted, the working miner unwaveringly adheres to the condition that he must receive a wage which will not merely enable him to live, but to live in what he considers to be comfort. Further, if the profits are to fix the wages, it would be deemed unfair by the men to take them for such a limited period as one year, inasmuch as the past twelve months have admittedly seen many firms hard pressed, in consequence of large contracts proving unprofitable in the changing times. A period of three years would stand a better chance of acceptance, as the men declare that among the firms now claiming to have worked at a loss during recent months are some that, within the longer period named, have made 50 per cent. profit. These, Mr. Ashton remarks, are substantially the views of the miners upon the question of arbitration; and as they are hardly likely to be generally endorsed by the employers, he thinks a settlement by arbitration appears improbable. A number of meetings of miners in the various centres of Nottinghamshire were held, when resolutions were submitted in favour of the men returning to work, where possible, at the old rate of pay, and in every instance were adopted. A meeting of about 3000 miners was held at Garswood, near St. Helen's. Mr. N. Walkden, the Secretary for the miners, proposed a resolution to the effect that the meeting approved of the efforts to bring the crisis to an end at an early date, but strongly protested against any reduction—believing that wages were too low to enable the men to maintain themselves, their wives, and children in a respectable manner; and it was carried. The Pelsall coalowners who were parties to the agreement that the miners should resume work at the old rate of wages re-opened their collieries to-day; thus providing employment, though not immediately, for about 19,000 men. A suggestion was brought forward in *The Times* by a South Wales Steam Coal Proprietor, for putting an end to the existing strife. His plan is to establish for a term of years one general uniform sliding-scale for the regulation of wages applicable to the whole of the coal-fields in the kingdom, and based on the principles of the South Wales sliding-scale, which, he says, has worked admirably for a period of 18 years, and conferred incalculable benefits on the coalowners and miners of that portion of the Principality. Assuming acquiescence in the proposed scheme, the question arises as to how it is to be brought into quick operation. The writer suggests that "Mabon," for South Wales, and Mr. Pickard, for the English Federation, "should nobly cast away their personal antipathies and prejudices," and invite the representatives of the Durham and Scotch miners to meet them at a round (or square) table conference, and agree on the terms of a general sliding-scale, and afterwards have a conference with the representatives of the associated coalowners. These meetings might be held in a very short time, if the leaders would suppress their animosities and prejudices, and agree, in a broad, friendly spirit, to become partners in a great national industry. Pending the settlement of the terms of partnership, all the men on strike should be allowed to go to work at once at the old rate until after the first audit, which will fix the future wages. He adds that present prices of coal fully justify the old rate of wages.

Thursday was an eventful day. A private conference, convened by the Home Secretary, including several leading officials of the Home Office, together with the chief constables of all counties in which strikes are in progress, and the Adjutant-General, as representing the War Office, took place in the Home Office. It had no special reference to recent events at Featherstone, but was called for confidential consultation as to the best means of maintaining or restoring order in any districts where labour disturbances might take place. There is to be an inquiry into the Featherstone affair; and it will be an open one. A meeting of the Coalowners' Federation was held at the Westminster Palace Hotel—Mr. A. M. Chambers in the chair. The proceedings were private; but, at their close, an official report was issued. A letter received from Mr. Ashton, Secretary of the Miners' Federation, was read and considered. The writer stated that he was instructed to say that the miners' representatives were prepared to meet the coalowners at any time or place they might appoint. He enclosed a copy of the resolution passed at the conference of the Miners' Federation at Nottingham on the previous Friday, as given in the JOURNAL last week (p. 551). It was unanimously resolved as follows: "The coalowners regret to see that the resolution passed by the Miners' Federation at Nottingham is to the effect that no reduction in wages is to be agreed to. This is merely a repetition of the suggestion which was made to the coalowners in Mr. Ashton's letter of the 25th of August last, and considered at their meeting on the 29th of the same month. The coalowners are not prepared to encourage false hopes by accepting a meeting on such a basis. But at the same time they are quite willing to meet the miners' representatives to discuss the proposed reduction; and they authorize the Executive Committee to meet them at such time and place as the Secretaries for the two bodies may agree upon." It was also resolved to send a copy of the resolution to the papers, and to Mr. Ashton. It was announced that Mr. Parker Rhodes had been compelled, owing to his holding the office of Clerk to the Magistrates for the West Riding Division, by whom the cases in connection with the recent rioting would be heard, to relinquish his position as Joint Secretary of the Coalowners' Federation. The settlement with the miners in the Forest of Dean was reported to the meeting and approved. A special executive meeting of the Yorkshire Miners' Association was held at Barnsley, at which Mr. B. Pickard, M.P., was present. The wages question was thoroughly considered; and it was decided to recommend that, in cases where the men could resume work at the old rate of wages, they should be permitted to do so. The meeting further requested that a ballot of the whole of the miners of Yorkshire should be taken on the question immediately. Mr. Pickard, referring to the result of the meeting in London, said it was evident that the battle would have to be fought to the bitter end. A conference of Scottish miners' delegates was held in Glasgow—all the districts being represented except Fife and Clackmannan. The reports submitted showed that generally the recommendation of the last conference to work four days a week had been followed. The Chairman (Mr. Chisholm Robertson) submitted a motion recommending the miners of Stirlingshire, Ayrshire, Lanarkshire, Dumbartonshire, and the Lothians, to continue working five days a week—having one fixed idle day. An amendment was brought forward recommending a four-day policy, which it was urged was the most rational one in the present emergency. The motion was carried by 23 votes to 13. Some of the miners employed at the Kilburne Collieries, near Derby, resumed work; and, by doing so, they appeared to give offence to other miners in the district. The old rate of wages was accepted. The returning miners were well guarded by the extra police; but the hooting by the outsiders was such that it was questionable whether the men would care to remain. It was believed that there would be a general resumption of work on the 25th.

At a meeting of the Executive Board of the Midland Miners Federation last Friday in Manchester, a resolution was passed disapproving the action of the Forest of Dean miners in objecting to a 20 per cent. reduction, and also their acceptance of the sliding-scale. The meeting agreed that a resolution should be submitted to the districts composing the Midland Federation, and that a special conference should be called to consider the attitude of the Federation in reference to the Forest of Dean. The Secretary of the Miners' Federation (Mr. Ashton), being questioned at Manchester regarding the decision of the owners at their meeting held in London, said he would not take any steps himself to bring about a joint meeting. If the resolution came to by the owners had been an open one, without reference to the reduction of wages, there would have been no difficulty in arranging a meeting of representatives of each side at once. In any case, the course of the owners precluded the men from assembling so early as they might otherwise have done. The Executive of the Miners' Federation would meet again to consider the situation. He added that contributions to the miners' fund were coming in from all parts of the country, especially from London; and the prospect became more hopeful daily. The miners in the Leeds district received their weekly strike pay on Friday. The amount was only 7s. per member, instead of 9s.; and a further reduction would, it was said, be made this week. A change took place among the miners on strike in Derbyshire; the Union pay having suddenly ceased, after the men had been assured that they had plenty of funds wherewith to fight the battle. It was decided to try to get money on loan from members of Parliament

who secured mining votes at the last election; but the result was regarded as problematical. The executive of the Northumberland Miners' Association issued an important circular in explanation of the refusal of the owners of an advance in wages. The circular stated that the price was 5s. 6·95d. per ton; being an increase of 2·35d. over the preceding quarter. "In urging the claim for an advance," continues the circular, "we referred to the increase of prices above mentioned. We also contended that the current prices will show a further increase, and that, in consequence of the very extensive strike in the South of England and the enhanced prices obtained, the miners should participate in this increase by having a substantial advance of their wages. We also dwelt upon the fact that the Northumberland miners had worked with great steadiness and regularity as an additional argument why their claims should receive favourable consideration."

The situation in Derbyshire at the close of the week was very unsatisfactory. Several colliery proprietors made preparations for reopening the pits at the old rate of wages; but the men were advised by their leaders not to go in until the dispute had been thoroughly settled. The men were greatly disappointed; and the public denounced in very strong terms the policy adopted. At Swadlincote, near Leicester, it was decided to allow the men to resume work at the Granville and Cotton Park Collieries at the old rate; and the news was hailed with great joy by the miners. In Lancashire there were indications of a settlement of the dispute; the men at some of the pits returning to work at the old rate, and certain of the large collieries showing signs of re-starting.

The demands upon the Durham coal-field for supplies of coal and coke for South and West Yorkshire, Lancashire, Derbyshire, and the adjoining centres grew much larger during the past week. High rates were offered and paid; but even a considerable excess on old prices was frequently ineffective in securing fuel. This was as much due to the inability of the North-Eastern Railway Company to transport the coal as to any failure of supply on the part of the collieries. No inconsiderable portion of the whole of the coal going from Durham was absorbed by the Midland and Great Northern Railway Companies for locomotive and other consumption; and this necessarily lessened the supply for ordinary manufacturers, gas making, and other purposes.

With regard to the effect of the strike on gas undertakings, the Altrincham Gas Company have had to raise the price of gas 2d. per 1000 cubic feet as from the end of the current quarter, owing to the high price they have had to pay for coal. At Burslem, the Gas Committee have had to give instructions for the purchase of coal slack, to the extent of 200 tons, at an advance of £50 on the contract. At Cleckheaton, on Tuesday, the stock of coal was expected to last only a fortnight; and it was decided to augment the stock by giving an order for 50 tons of a special kind. At Halifax, the Gas Committee went on until they were within sight of the end of their stock of coal; and then they gave orders for 5000 tons—1000 tons from Yorkshire, and 4000 tons from Durham. There was a prompt delivery of a portion; and it was thought that the remainder would provide sufficient coal for a month. The contract was effected on reasonable terms. The Gas Committee of the Leeds Corporation decided last Thursday to purchase between 7000 and 8000 tons of coal, to be delivered at prices ranging from 12s. 9d. to 15s. 3d. per ton. The average price paid for Yorkshire coal at ordinary times is about 10s. 3d. per ton. The stocks of coal at the works have been gradually diminishing; but, with the latest purchases, there will be sufficient to last several weeks. At Normanton, the trouble experienced through the strike was not so much in procuring the coal, as in getting it delivered at the works. The carter engaged was objected to by the miners on account of his being a non-society man; and so he had to give place to another. Owing to the scarcity of coal and the high price charged for what is obtainable, the public lighting at Pinxton has been discontinued.

In France and Belgium the tactics of international Socialism were apparent last week in an agitation started among the miners. On Monday, there were 42,000 men on strike in the Pas de Calais district; and the President of the Unions there counselled striking in Belgium—the present being, he said, a favourable opportunity for doing so. One of the men's leaders declared that "at all cost the stoppage must be complete throughout the Nord and the Pas de Calais." In a circular distributed on Tuesday to the Lourches miners, the socialistic tactics were admitted. "Your brothers of the Pas de Calais, of Belgium, and of England count on you," said this circular, "to take part in the general strike." In the Liége district, the leaders deprecated a strike; and the miners took little interest in it. In Paris, the coal merchants have not attempted to lay in winter stocks; hoping for assistance from the Gas Company, who have large quantities of coal in store.

Burghs Gas Supply (Scotland) Act, 1876, Amendment Bill.—This Bill received the Royal Assent last Friday.

Fatal Electric Light Accident.—On Tuesday, the 12th inst., an accident occurred at a sub-station of the London Electric Supply Corporation in the Blackfriars Road, causing the instantaneous death of the linesman in charge (a man named Robert Ball), and severe injuries to his assistant. It appears that, soon after six o'clock, Ball threw the plant on one side of the station out of action, and then sent his assistant, named Ernest Meech, to clean the gearing; but he forgot to remove the plug on the "omnibus" bar. Consequently, the 2400-volt current was sent back on to the low-tension side of the transformers; and cleaning the apparatus the assistant experienced a powerful shock. He immediately shouted for help; and Ball came up and attempted to assist him out of his danger. He thereupon received the full force of the current, and was instantly killed. Ball had been for six or seven years in the service of the Corporation, and two years in charge of the Blackfriars station. An inquiry was opened last Friday week at Guy's Hospital, to which the unfortunate man was removed, by Mr. A. C. Langham, the Coroner; Mr. J. A. Redgrave attending the inquiry on behalf of the Home Office, and Major Cardew representing the Board of Trade. Mr. J. G. Freeman, the Engineer in charge of the station, expressed the opinion that nobody but deceased was to blame, as he should have removed the plug. The inquiry was adjourned for a month.

METROPOLITAN WATER SUPPLY COMMISSION.

The Commissioners' Report.

The report of the Commissioners appointed to inquire into the Metropolitan Water Supply, which was laid upon the table of the House of Commons on the 14th inst., has since been issued as a Blue-book. It extends to upwards of 72 pages, of which 70 are occupied with an analysis and explanation of the evidence submitted. Then come the Commissioners' recommendations and conclusions, which were dealt with in the JOURNAL last week. The following is a general outline of this important inquiry.

The Commission, which was appointed in January, 1892, consisted of Lord Balfour of Burleigh (Chairman), Sir G. B. Bruce, M.Inst.C.E., Professor J. Dewar, F.R.S., Sir A. Geikie, F.R.S., Mr. G. H. Hill, M.Inst.C.E., Mr. J. Mansergh, M.Inst.C.E., and Dr. W. Ogle; and it was constituted for the purpose of ascertaining "whether, taking into consideration the growth of the population of the Metropolis and the districts within the limits of the Metropolitan Water Companies, and also the needs of the localities not supplied by any Metropolitan Company, but within the watersheds of the Thames and the Lea, the present sources of supply of these Companies are adequate in quantity and quality, and, if inadequate, whether such supply as may be required can be obtained within the watersheds referred to, having due regard to the claims of the districts outside the Metropolis but within those watersheds, or will have to be obtained outside the watersheds of the Thames and the Lea." For the purpose of acquiring the information necessary to enable them to form a judgment upon the questions submitted, the Commissioners placed themselves in communication with the Metropolitan Water Companies, the Corporation of the City of London, the London County Council, and the Councils of the counties of Bedford, Berks, Buckingham, Essex, Gloucester, Hants, Hertford, Kent, Middlesex, Oxford, Surrey, and Wilts. They also invited the Boards of Conservators of the Thames and Lea, and all the Urban and Rural Sanitary Authorities whose districts are wholly or partially situated within the watersheds of those rivers, and all the Water Companies and public authorities who have water-works in the same area, to give them any information bearing on the subject which they might be in a position to afford. The Commissioners sat on 45 days, 32 of which were occupied in hearing oral evidence. There were 92 witnesses examined, most of whom were put forward by the Metropolitan Water Companies or the County Councils of London and the counties of Hereford, Middlesex, Surrey, Essex, and Buckingham, and by other public bodies in London and the neighbourhood. Some of the evidence produced was of such a character that it was found necessary to employ an Assistant Commissioner to visit the localities under inquiry and to ascertain upon the spot the precise facts. For this purpose, with the sanction of the Treasury, Mr. R. E. Middleton, M.Inst.C.E., was appointed.

The inquiry, as far as possible, was conducted in two divisions, the first of which comprised all the particular evidence as to the individual circumstances of the Water Companies at the present time, and the anticipations of the future which might be based upon them. Under this division was taken the evidence of the Metropolitan Water Companies as to the quantity of water which they were daily supplying per head of the population; the sources at their command to meet that supply, and the grounds upon which, in their opinions, future demands ought to be based; the evidence of the officers of the Conservators of the Rivers Thames and Lea as to the powers of the Water Companies to abstract water from those rivers, and the measures taken to prevent their pollution; the evidence as to the amount of rainfall in the valleys of the Thames and Lea, and the existing pollutions of these rivers; evidence prepared at the General Register Office as to the populations of the areas affected by the inquiry; and, lastly, evidence offered by councils of counties and by corporations and local boards within the watersheds. Nearly the whole of this division of the evidence was taken before the end of July, 1892; and the sittings of the Commissioners since the month of October of that year were mainly devoted to the second division of evidence, which included the general evidence of engineers, geologists, chemists, and bacteriologists bearing upon the subject as a whole.

The areas affected by the inquiry may be defined as extending over "Greater London" as that name is used in the General Register Office, where it is applied to the area included within the Metropolitan and City Police districts. Such area includes all parishes wholly comprised within a circle of 15 miles radius from Charing Cross, and all other parishes of which any part is included within a circle of 12 miles radius from the same centre. Greater London thus not only includes the whole of the Administrative County of London, but extends widely beyond it, and contains in all an area of 701 square miles. In the evidence given before the Commission, the area within Greater London and outside the county of London was called the "outer ring;" and it is within this area that at present the most rapid increase of population appears to be taking place. The areas supplied form together a district usually spoken of as "Water London," comprising about 620 square miles. The areas are not co-extensive with any districts of which the populations are given by the Registrar-General in the census returns; and, no exact statement of the population being obtainable from official returns, the Companies found it necessary to rely upon estimates compiled from such other sources of information as they had at their command. According to the returns made by the Companies themselves, the total population supplied by them in 1891 was estimated at 5,490,791; but it would seem, however, that 5,237,062 persons must be accepted as the closest approximation that could, under the circumstances, be made.

In turning to the future requirements of this ever-increasing population, the first question that presented itself for discussion was what area ought to be taken into account, and it soon became apparent that neither Registration London, nor the London of the County Council, nor even Water London was sufficiently entensive for the purpose. Not only should suburban districts be included in the area

to be reported upon by the Commission, but such more remote districts must be considered as might reasonably be expected to be reached by the spreading of the population of London at no very distant time. After due consideration, the Commissioners determined to take as their basis that area known as Greater London, and to add to it certain parts of Water London which lie outside Greater London as now computed. The report states that the increase in population of this area, as shown by the census returns for the last 50 years, has been far from equable. Taking, however, the average annual increase per cent. in the whole period as a basis, they think it may safely be computed that the population of Greater London will continue to increase at the rate of 18·2 per cent. decennially, or in the ratio of 1·68458 per cent. annually.

The report sets out at length a table showing the yearly and monthly daily average bulk of water returned to the Official Water Examiner under the Metropolis Water Act, 1871, as supplied by the Companies in the year 1891. From this and similar calculations made from other returns, it appears that the quantity of water consumed per head of the population differs widely in the districts of the several Companies. Taking the population estimated by them as being actually supplied, the quantities consumed per head per day range from 26·71 gallons in the case of the West Middlesex Company to 47·72 gallons in that of the Grand Junction Company; the average over the whole of the population being 31·19 gallons per head per day. The report next gives the present sources from which the water supplied by the Companies is derived. These are of four kinds—viz. (1) the Rivers Thames and Lea; (2) gravel beds adjoining the main stream of the Thames and other gravel beds at Hanworth; (3) natural springs; and (4) wells sunk into the chalk or other strata at such points in the watersheds as may have been selected. The Commissioners discuss these in the order named. All the Companies, except the Kent Company, are dependent for some part of their supply upon water derived either from the Thames or the Lea.

Turning to the question of the "necessities of the future," the Commissioners set out in the report the views of the several Companies, who adopted the same term—viz., 40 years—as the period for which it is desirable to look forward. The following table gives the figures laid before the Commission by each Company as to the estimated population and requirements of their district in 1931:—

Name of Company.	Estimated Population in 1931.	Estimated Daily Supply per head in 1931.	Supply required per Day.	Supply available per Day.
New River	1,658,000	28·5	47,250,000	*56,500,000
East London. . . .	1,697,000	33·0	56,000,000	66,000,000
Chelsea	375,000	35·0	13,125,000	22,000,000
West Middlesex. . .	959,187	28·0	26,857,236	24,500,000
Grand Junction . . .	584,969	42·0	24,500,000	24,500,000
Lambeth	1,136,441	25·0	28,411,025	30,500,000
Southwark and Vauxhall	1,215,457	25·0	30,386,425	41,000,000
Kent	900,000	30·0	27,000,000	29,000,000
Total	8,526,054	29·73	253,529,686	294,000,000

* Deducting 330,000 gallons of unfiltered water from Hampstead Ponds.

The suggestions made by the Companies for extending their works, and so augmenting the volume of distributable water, may be stated as follows: (1) The abstraction of more water from the Thames without providing storeage. (2) The abstraction of more water from the Thames and Lea with provision for storeage. (3) The abstraction of water from gravel beds adjoining the Thames. (4) The abstraction of more water from deep wells in the chalk formation.

The report next proceeds to deal with the several suggestions which were laid before the Commissioners as to the construction of large storeage reservoirs. Of the schemes submitted, that of Messrs. Hunter and Fraser was considered the best. It was brought forward by Mr. W. Hunter, M.Inst.C.E., a Director, and Mr. Alexander Fraser, M.Inst.C.E., the Engineer, of the Grand Junction Company. It consists in the construction of nine reservoirs upon land in the neighbourhood of Staines, at a spot only a few miles from the existing works of the Company. The storeage capacity was to be obtained by excavating below the surface in almost flat ground, and forming the material removed into banks so as to increase the depth. By this combined process of sinking and raising, a depth of 40 feet would be obtained; the digging being entirely in gravel, which overlies the clay to a depth of from 20 to 30 feet. The advantage rightfully claimed for this scheme was that it could be carried out by instalments, as might be from time to time required.

After setting out the evidence given as to the estimated supply of water that could be procured from gravel beds and deep wells, the report summarizes the total capacity of the supply as returned by the representatives of the Companies as follows: From the Thames, with additional storeage, 300,000,000 gallons per day; from the Lea, with the East London Company's projected storeage, 52,500,000 gallons; from chalk springs and wells, 87,000,000 gallons—total, 439,500,000 gallons, or (say) 440 million gallons per day.

The report next deals with the objections which have been raised to the proposals of the Companies in regard to increasing the draught upon the Thames, the Lea, and the chalk formation, for the purpose of meeting further demands; and the conclusions arrived at by the Commission are stated as follows:—

"*From the River Thames.*—In estimating the quantity of water which may be obtained from the Thames, we have given full consideration to the topographical, meteorological, geological, statistical, and engineering evidence which has been laid before us by the representatives of all the parties, although we shall now quote figures only from a few of the proofs. The area within the Thames watershed down to Kingston was assumed by the Duke of Richmond's Commission (on evidence then received) to be 3676 square miles; and this figure has been adopted by Mr. Hawksley, Mr. Baldwin Latham, and others in the present inquiry as the area down to Teddington Weir. Both Mr. More and Mr. Binnie have made new and independent admeasurements, and compute this area respectively at 3766 and 3789 square miles; and as Mr. More (being Engineer of the Thames Conservancy) may be assumed to possess the fullest acquaintance with the watershed, we propose to adopt his figure. From Mr. Topley we accept 3548 square miles as being approximately the area above the intakes of the Water Companies. Mr. More has put in gaugings of the discharge of the Thames at Teddington for the years 1883 to 1891, with an added column showing the rainfalls, which are as follows:—

Year.	Total Quantity of Water abstracted by the Water Companies.	Volume of Discharge at Teddington Weir, as gauged by the Thames Conservancy.	Total Flow of the River Thames. Col. 2 + Col. 3.	Average Annual Rainfall on Thames Basin, above the Intakes of the Companies.
	Gallons.	Gallons.	Gallons.	Inches.
1883 .	26,197,000,000	659,657,000,000	685,854,000,000	28·41
1884 .	29,946,000,000	330,648,000,000	360,594,000,000	22·90
1885 .	29,654,000,000	399,130,000,000	428,784,000,000	29·15
1886 .	30,350,000,000	544,786,000,000	575,136,000,000	31·07
1887 .	32,154,000,000	390,296,000,000	422,450,000,000	21·32
1888 .	30,280,000,000	427,656,000,000	457,936,000,000	28·45
1889 .	31,419,000,000	437,059,000,000	468,478,000,000	25·64
1890 .	32,876,000,000	261,916,000,000	294,792,000,000	22·81
1891 .	35,185,000,000	472,228,000,000	507,413,000,000	33·31
Total.	278,061,000,000	3,923,376,000,000	4,201,437,000,000	243·06
Average of the nine years	30,896,000,000	435,931,000,000	466,827,000,000	27·01

"In the third column of this table, the average yearly discharge of the nine years at Teddington is given as 435,931,000,000 gallons. But this quantity is subject to some correction; for we found, on investigating the details of the gauging arrangements at Teddington, that it was desirable to check the results by simultaneous measurements at Molesey and Sunbury Weirs, and having entrusted this work to Mr. Middleton, and considered his report, we accept his opinion that Mr. More's quantities should be increased by 7 per cent. To the 435,931,000,000 gallons we therefore add 30,515,170,000 gallons—making 466,446,170,000 gallons. To this again must be added the average quantity taken by the Companies—viz., 30,896,000,000 gallons; giving a grand total of 497,342,170,000 gallons. Divided by 365, this gives a daily average of 1,362,581,288 gallons.

"But during the nine years in question the rainfall averaged only 27·01 inches, as compared with 28·50 inches which Mr. Symons gives as the mean fall of a long term upon the watershed. We therefore increase the daily volume to 1,437,747,750 gallons; raising it in the ratio of 27·01 to 28·50 inches. This quantity must, however, be reduced in the proportion of the area above Teddington—viz., 3766 square miles—to that above the intakes, which is 3548 square miles; thus bringing down the net daily quantity to 1,354,521,778 gallons. This, we believe, is a very close approximation to the average daily flow of the Thames down to the water-works intakes during a long series of years; and we will call it, in round figures, 1,350,000,000 gallons. The average daily discharge of three consecutive dry years we estimate at 1,120,000,000 gallons, and of the driest year at 900,000,000 gallons.

"These being the facts, we are of opinion that, by the construction, in the neighbourhood of Staines, of reservoirs of adequate capacity, into which water shall be pumped and stored in times of excess, to be used in times of deficiency, at least 300,000,000 gallons a day may be obtained for the supply of London. We believe this can be done without taking in the more turbid of the flood waters, and without injuriously diminishing the volume of the river below the point of abstraction. To ensure the best results in both these respects, the taking of the water should be subject to strict regulations laid down by Parliament. The water allowed to be taken from the river should, in our opinion, include any water which may be pumped from the gravel beds in the vicinity of the river.

"*From the River Lea.*—The available drainage area of the Lea above the lower intake of the East London Company is stated by Mr. Bryan to be 460 square miles; and the mean rainfall upon it is stated by Mr. Symons to be 26 inches. No gaugings of the discharge have ever been made at or below the intakes; but they have been kept for many years at Feilde's Weir, which has above it (as before stated) an area of 422 square miles. From this area we have made out that, on the average of three consecutive dry years, 81,000,000 gallons a day will flow off by the river. We have had no definite evidence as to the capability of the district below; but, from some remarks of Mr. Bryan's, we judge that he does not calculate upon getting an additional quantity proportional to the whole area, and we shall probably be safe in calling the total available quantity 85,000,000 gallons. Of this, the New River Company draw 22,500,000 gallons direct from the river above Ware; and the East London Company have at times taken 37,000,000 gallons. Dealing with the river as a whole, this abstraction is, in our opinion, too great with the storeage now in existence; but if other reservoirs were constructed, adequately increasing the storeage capacity on well-recognized lines, 52,500,000 gallons a day may be obtained. The taking of the water should be under regulations similar in character to those suggested for the Thames—viz., the first flush of floods to be rejected, and in dry weather no water to be abstracted when the flow has run down to a quantity hereafter to be determined.

"*From Wells in the Lea Valley.*—Into this part of the case, we have already gone very fully; and we need only repeat here that in very dry years the Companies should not calculate on obtaining more than 40,000,000 gallons a day.

"*From the Chalk on the South Side of the Thames.*—From the existing wells of the Kent Company, and others which may be sunk within

their district, we think that 27,500,000 gallons a day may safely be taken. From the tract of chalk country in the valley of the Medway, and the larger area farther eastwards to the coast, a very considerable addition is also undoubtedly procurable.

"The summary of the several quantities above stated is as follows: From the River Thames, 300,000,000 gallons per day; from the River Lea, 52,500,000 gallons; from wells in the Lea Valley, 40,000,000 gallons; from wells in the Kent Company's district, 27,500,000 gallons—total, 420,000,000 gallons, sufficient, at 35 gallons per head per day, for a population of 12,000,000."

Of those witnesses examined whose evidence was directly adverse to the reservoir and storeage schemes put forward by the Companies, that of Mr. A. R. Binnie, M.Inst.C.E., Chief Engineer to the London County Council, was the most important. Mr. Binnie's evidence was to the effect that the supply that could be drawn from the Thames and the Lea was wholly insufficient to meet the future wants of Greater London; and he stated that, in his opinion, deep storeage reservoirs in the Thames Valley were impracticable, and, further, that any large increase in quantity pumped from the chalk formations would only ultimately diminish the amount of surface water in the various contributory streams, and therefore could not be reckoned on for increasing the supply. The weight of evidence given before the Commission went to rebut Mr. Binnie's evidence; and it will be seen from the extracts given from the report that the Commissioners did not accept his views. They unanimously recommended the adoption of additional storeage works in the Thames Valley, and rejected those plans which advocated supplying the Metropolis with water from an entirely new watershed, as such a course would involve the water being brought from a great distance, which could only be carried out at a very serious and, in their opinion, unnecessary expense.

EAST LONDON WATER-WORKS COMPANY.

The Half-Yearly Report.

The report of the Directors of this Company for the six months ending June 24 last, which will be presented at the half-yearly general meeting of the proprietors on the 5th prox., shows that the revenue from all sources was £144,539, as compared with £141,157 in the corresponding period of the past year; being an increase of £3382. The expenditure was £63,389, against £58,346—an advance of £5043. There is a slight diminution in the sum carried to dividend and interest account—from £77,811 to £76,150; but the Directors point out that certain items of expenditure (including the payment to the Chamberlain of London under the Company's Act of 1886) all stand higher than during the first half of 1892. They therefore consider the result of the working may be deemed satisfactory. The new well at Chingford Mill has been carried to its full depth; and tunnelling will be commenced as soon as pumping machinery of adequate power can be provided. The capital expenditure on works and mains amounted to £19,813 in the half year. The quantity of water pumped was 8,263,505,543 gallons, as compared with 8,085,661,949 gallons in the corresponding period of 1892. The new services laid on numbered 1878, against 2120; the total number now in supply being 174,983. The Directors think it is matter for sincere congratulation that, despite the long and unprecedented drought, the supply of water has been well maintained. The chalk wells have greatly contributed to this satisfactory result during a most trying season. The reports of Dr. Frankland, as well as those from Professor Crookes and Dr. Odling, continue to show the water supplied by the Company to be of a high standard of purity. Referring to the report of the Royal Commission, the Directors are extremely glad to find that the conclusions of the Commissioners are very favourable to the Water Companies, as to the quality and quantity of the supply furnished to the consumers. This decision of the Commissioners is unanimous, and must, in the opinion of the Directors, be deemed highly satisfactory and reassuring both to the inhabitants of the Metropolis and to the proprietors of water stock. As already stated, the Directors recommend a dividend on the ordinary stock at the rate of 8 per cent. per annum (less income-tax). This will absorb £68,780, and leave an unappropriated balance of £7767 to be carried forward.

Lincoln Corporation Gas and Water Supply.—An abstract of the accounts of the Lincoln Municipal and Urban Sanitary Authority for the year ending March 25, prepared by the City Auditor (Mr. J. S. Battle), has just been issued. The expenditure in connection with the gas undertaking came to £34,009, of which £19,724 was for making, and £1317 for distributing gas, which brought in a revenue of £24,572. There were 19,812 tons of coal carbonized; and the production of gas was about 200 million cubic feet. The reserve fund amounted at the close of the financial year to £15,303. In regard to the Water Department, the receipts were £9544; but out of these had to be paid the maintenance and working expenses, £3115, and interest, &c., on loans, £6154. The quantity of water pumped last year (according to the report of the Water Engineer (Mr. H. Teague) was 445,345,047 gallons; being an increase of 24,891,687 gallons on that of the year 1891-2.

New Joint-Stock Companies.—The Irthlingborough Gas and Coke Company, Limited, has been registered with a capital of £1000, in £10 shares, to supply gas in the town named, in Northamptonshire; and the Hydrocarbons Products Syndicate, Limited, with a capital of £50,000, in £1 shares, to adopt an agreement made between Mr. J. H. W. Stringfellow and Mr. E. H. Wood for the acquisition of the patents granted to the former in connection with the manufacture and purification of gas, and to carry on the business of mechanical and gas engineers and manufacturing chemists. Among the signatories to the Memorandum of Association of the latter Company are Mr. E. H. Woods, M.Inst. C.E., of 6, Victoria Street, S.W.; Mr. E. H. Stevenson, M.Inst.C.E. (Messrs. Stevenson and Burstal), of 38, Parliament Street, S.W.; and Mr. J. W. Burchell, of the firm of Messrs. Burchell and Co., Solicitors, of 5, The Sanctuary, Westminster. Mr. Woods and Mr. Stevenson are among the first Directors.

METROPOLIS WATER SUPPLY.

The Quality of the Water in the Month of August.

The returns furnished to the Registrar-General by the London Water Companies with regard to the water supply of the Metropolis during the past month, show that the average daily supply was 209,804,877 gallons, as compared with 197,911,049 gallons in the corresponding month of 1892. The number of services being 797,038, the rate was 263 gallons to each service. Of the entire bulk of water sent out, 106,294,804 gallons were drawn from the Thames, and 103,510,073 gallons from the Lea and other sources. Reporting upon the quality of the supply, Dr. E. Frankland said: Taking the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies and by the Tottenham Local Board of Health was: Kent, 0·8; Tottenham, 0·9; East London (deep well), 1; New River, 1·1; East London (river supply), 1·5; Colne Valley, 1·8; Chelsea, West Middlesex, and Lambeth, 2·4; Southwark, 2·6; and Grand Junction, 2·7. The unfiltered river waters contained the following proportions: New River Cut, 1·9; East London intake, 2·7; and the Thames at Hampton, 3·8. The Thames at Hampton was, on Aug. 10, turbid and pale yellow. It was, however, both chemically and bacterially, in considerably better condition than on the 19th of July last. Contrasted with the unfiltered water, the supplies of the five Companies drawing from the Thames showed great chemical, and the following percentage bacterial improvement: Chelsea, 88·39; West Middlesex, 92·67; Southwark (filter No. 3), 98·95, (filter No. 4) 98·57; Grand Junction (Hampton local supply), 97·05; and Lambeth, 96·25. The water was in every case efficiently filtered. The unfiltered water, taken chiefly from the River Lea, was chemically of about the quality as on the 20th of July last, but bacterially of very much better quality. It was turbid and very pale yellow in colour; but, before being supplied, it was improved bacterially to the extent of 97·39 per cent., and was fully equal in chemical purity to the deep-well waters. It was efficiently filtered before delivery. The raw river water taken from the Lea at Angel Road on the 9th of August was turbid and pale yellow. It was both chemically and bacterially of better quality than on the 20th of July last, although it still contained more than three times as many microbes in a given volume as the Thames water, which was bacterially examined on the following day. It was efficiently filtered before delivery, and was so far improved chemically, as to make it rank among the deep-well waters; while on the average, and contrasted with the raw water, 97·57 per cent. of the microbes were removed by storeage and filtration. The deep-well waters of the Kent, Colne Valley, and East London Companies, and of the Tottenham Local Board of Health, were of excellent quality for dietetic purposes. All these waters were clear and bright without filtration, except that of the East London Company, which was very slightly turbid, owing to the presence of a trace of mineral matter. The Colne Valley Company's water was softened before delivery, and thus rendered suitable for washing. Seen through a stratum 2 feet deep, the Kent, Colne Valley, Tottenham, and New River waters were clear and colourless; the East London deep well, very slightly turbid and colourless; the East London river supply clear and nearly colourless; and the remaining waters, clear and very pale yellow. The bacteriological examination of the raw river water, and of those supplied by the various Companies, collected on the 9th, 10th, 11th, and 12th, gave the results contained in the following table:—

Description.	No. of Microbes per Cubic Centimetre.	Temperature in Deg. C.
Raw River Waters.		
Thames at Hampton	1895	21·3
New River Cut	1303	20·0
Lea at Angel Road	6658	21·2
„ after storeage	421	20·2
River Supplies.		
Chelsea	220	21·6
West Middlesex	139	20·3
Southwark, No. 3 bed	20	20·7
„ No. 4 bed	27	20·9
Grand Junction, Hampton, Local Supply	56	21·3
Lambeth	71	21·3
New River main filter-shaft (*a*)	34	19·3
East London, No. 12 bed	113	19·8
„ „ No. 11 bed	210	19·4
Deep Well.		
Kent	16	11·3

In the course of their report for the past month to the Official Water Examiner (General A. de Courcy Scott, R.A.), Messrs. Crookes and Odling say: "Of the 182 samples submitted to analysis, six were recorded as "clear but dull;" the remainder being clear, bright, and well filtered. The long-continued dry weather, which had lasted from March to the middle of June, showed signs of breaking during the latter month; and, when writing our last month's report, we were able to say that the rainfall for July had been 3·70 inches at Oxford, whereas the mean fall for 25 years was 2·58 inches—showing an excess of 1·12 inches. The effect of this was shown in a table, by which it was seen that the sudden and excessive rainfall, following one of the longest droughts ever recorded, was extremely slight in respect to the variation in quality of the Metropolitan water, and imperceptible in respect to any injurious tendency. This excessive rainfall was not kept up during August. The mean fall for this month, over an average of 25 years, is 2·24 inches at Oxford, while the actual fall has only been 1·01 inch; showing a deficiency of 1·23 inch. During the whole of the month, there were only two really wet days—viz., the 4th, on which 0·35 inch; and the 22nd, on which 0·26 inch of rain fell; the rest of the month's rain, amounting to 0·4 inch, being distributed over eight days. The excess of rain in July being 1·12 inch, and the deficiency in August being 1·23 inch, it is seen that for the two months the rain has been 0·11 inch below the 25 years' mean; while, including

June, the three months' deficiency amounts to 1·55 inch. The dry August following the wet July has had the effect of minimizing the divergencies from the mean, which were shown in tabular form in our last month's report. The following table shows the most noteworthy points on which comment may be desirable :—

1893.	Common Salt per Gallon.	Nitric Acid per Gallon.	Oxygen required per Gall.	Organic Carbon per Gallon.	Organic Carbon per Gallon.*	Colour. Brown.	Blue.
June . .	2·155	0·601	0·033	0·065	0·083	—	: —
July . .	2·114	0·674	0·036	0·070	0·098	15·9	: 20
August .	2·161	0·705	0·034	0·067	0·084	15·3	: 20

* The figures in this column are maxima; the rest are means.

The common salt has slightly risen, as would be expected, from diminished dilution. The organic matter is a little less, as shown alike by the combustion test, the less amount of oxygen required for its oxidation, and the slightly diminished colour. The colour being of a vegetable, peaty origin, is higher than it is in colder weather; but the brown colour is a little less than it was in July. The nitric acid has risen, but only in the second decimal place; showing that, whatever the organic matter may have been at its entrance into the river, it has undergone efficient destruction before it leaves the Companies' reservoirs. From the 21st to the 28th of August, the colour of the water supplied by the Chelsea Company was somewhat below its usual high level. This was caused by a serious burst, which occurred in one of their large 30-inch pumping-mains. For a few days, during repair, the velocity of the water in the mains had to be retarded, occasioning a temporary deposit of harmless iron oxide. When the ordinary rate of flow was resumed, some of this deposit was carried through the mains, and caused a temporary discoloration; but in no case was the colour high enough to occasion a deficiency in brightness."

THE BRADFORD CORPORATION NEW WATER-WORKS.

In briefly recording last week the commencement of the great scheme of water-works extension for Bradford, by the formal cutting of the first sod on the site of the compensation reservoir about to be constructed at Gouthwaite in the Nidd Valley, we mentioned that the Chairman of the Corporation Water Committee (Alderman Holdsworth) made an interesting and concise statement concerning the steps which the Committee took to procure a further supply of water, and giving some information in regard to the projected works. His remarks were as follows: As far back as 1884, the Water Committee were forced to the conclusion that another source of supply must be found; and instructions were given to Mr. Binnie, the Engineer at that time, to explore the different watersheds to find out suitable areas that would yield a very large supply of water, adapted to the Bradford industry. Careful examination and investigation was made in the valley of the Skirfare, the upper reaches of the Wharfe, at Buckden, at Masham, on the Burn and the Ure, and on the Nidd; and there was also a long controversy about Grimwith (one of our compensation reservoirs) as to its fitness for a service reservoir. This extended over several years. Finally, the Nidd Valley was selected; and parliamentary powers were sought and obtained in 1890 to enable Bradford to take the head waters of the Nidd by a scheme laid out by Mr. Binnie, but to deliver the whole of the water to what is known as the low level, and it would, therefore, require to be pumped to a higher level for distribution. After the appointment of Mr. Watson, our present Engineer, he was asked if it was not feasible to bring the Nidd waters to Bradford to the higher level by gravitation, and thereby avoid the enormous and continuous expenses of pumping. After much thought and careful testing of the levels, Mr. Watson devised the scheme which is intended to be carried out, and which will bring and distribute these waters wholly by gravitation. This I am satisfied is the practical way of treating the scheme; and it will save a large annual expenditure, without much increase in the first cost of the new works. Fresh powers were granted by Parliament in 1892, to alter somewhat the positions of the impounding reservoirs from the parliamentary plans of 1890, and also to change the course of the line to Bradford. A brief description of the works under the changed circumstances may not be inappropriate. The drainage area set apart for Bradford in the Upper Nidd is over 18,000 acres, and is largely clean and unpopulated, extending from Woodale over the wide range of grass-covered sloping hills to the parting line of the watershed of Great and Little Whernside. In addition to the gathering area referred to, we are entitled to the many streams flowing from the western range of hills between Woodale and Burn Gill. I venture to say that, both as regards quantity and quality of the water, we have made a judicious and wise selection by choosing the Nidd for our extended water supply, and that future generations in Bradford will have reason to be proud of the courage of the present Council in entering upon such a large undertaking—works which during their construction, extending over several years, will require and demand constant care and watchfulness in order to bring them to a successful issue. Such attention I feel satisfied they will receive from our Engineer. The Gouthwaite compensation reservoir will form a beautiful inland lake, covering 330 acres, which is the same area as the Thirlmere Lake, which is to supply Manchester. It will be over two miles in length, will contain more than 1500 million gallons of water, and will certainly add to the beauty of the valley. Unfortunately for Bradford, it is for compensation only; and until this work is completed, Bradford cannot utilize the right granted to take water from this district. But, in order that no time may be lost in getting water to Bradford, we are now almost ready to advertise for tenders for the construction of 32 miles of main aqueduct and four miles of branch aqueducts. These include six miles of tunnels, twelve miles of cut-and-cover work, and fourteen miles of iron main 36 inches in diameter (which will at some future time have to be duplicated), together with numerous dams, weirs, inverted syphons, bridges, intakes, &c., forming part of one of the largest and most important works of water supply ever projected in Yorkshire. It is intended that the works shall be carried out in sections; and I recommend that we should now accept tenders to go right to the waters of the Nidd itself. In years to come, there large supply reservoirs can be constructed (and the drawings are already made) having a storeage capacity of 2595 million gallons. We shall require service reservoirs at Chellow Grange to hold 60 million gallons, with clear water-beds and filter-beds for the complete scheme; but for the present, one section only of the latter works is necessary. The main aqueduct and tunnels will deliver more than 23 million gallons per day; and the total estimated cost of the whole scheme is £1,330,000. Probably £700,000 will be wanted for the works proposed to be dealt with in the near future.

THE DROUGHT AND PROVINCIAL WATER SUPPLIES.

The rain which fell in the early part of last week, and the change in temperature, assisted in materially reducing the consumption of water in several towns; and this has in some measure allayed the anxiety which has been felt of late by many of the authorities responsible for the supply of water. There is consequently very little news on the subject worth chronicling this week. Perhaps the most important item is that the citizens of Dublin are saved—at all events for the present—from the use of the Grand Canal water. The economy that has prevailed in the city and townships during the past few days has resulted in a reduction of the quantity of water sent into the city from 15 million to 8 million gallons per day. This gave the Corporation Water Committee such a degree of confidence that last week they issued a notice stating that there was no necessity just now for altering the supply to the city or townships; and, in their exultation, they "returned their most sincere thanks to the townships for their assistance and co-operation in economizing the water supply." With regard to Leeds, we learn that at a large fire which occurred at the Central Market about midnight on Wednesday, the firemen were unfortunately hampered by an insufficient pressure of water, which is now turned off at the reservoirs every night; and, even when the water had been supplied after considerable delay, there was not enough pressure to reach more than half the building. The consequence was the flames were not subdued until four hours had elapsed; the damage being estimated at £80,000. At the end of last week, the amount of water in the Corporation reservoirs was only equal to 21½ days' supply, or 27 days with the aid of pumping. The people of Guisborough had also a very unpleasant proof last Sunday week of the exhaustion of the supply of the local Water Company. A fire broke out at the Station Hotel; and, as the only available supply of water was the small quantity which could be carried from neighbouring pumps, the building was soon completely destroyed. It may be remembered that, in the course of the debate on the water supply at the last meeting of the Newcastle City Council (as reported in these columns on the 12th inst.), it was stated that, in some instances, the River Tyne water was being used by workmen in factories for drinking purposes. Under these circumstances, an analysis of the water has been made by Mr. John Pattinson, the Corporation Analyst, with the result that he considers that, when well filtered, it is a pleasant and wholesome drinking water. If stored for some time in large reservoirs and well filtered, as he understands the Water Company propose doing, the yellowish-brown colour, which is only objectionable on account of its appearance, will, he says, no doubt be got rid of to a considerable extent. The reservoirs of the Newport Corporation at present contain nearly two months' supply, estimated at a consumption of 1,500,000 gallons of water daily. The Manager reports that during the past month 75,481 gallons have been received every day from the Henllys streams; and, in view of this, a considerable section of the ratepayers are somewhat uneasy at the determination of the Town Council to at once proceed with a scheme for obtaining a supply from Wentwood, at the enormous outlay of at least £120,000. Huddersfield has been in an exceptionally fortunate position as to water supply this summer. While many neighbouring boroughs have had to seriously curtail their output, and resort to various expedients to eke out their scanty stores. Huddersfield has maintained a constant service, and last Wednesday had still fifty days' supply in store. Alderman Crosfield nevertheless described the situation as serious; and he pointed out that, since the 2nd of March, when the reservoirs were practically full, the water had gradually gone down, until it was now unprecedentedly low. Their average stock was three or four times the present quantity; but he hoped they might be able to still maintain the full supply.

The Great Northern Railway and the Peterborough Water Supply.—The Great Northern Railway Company, who have for some time been prospecting for an independent source of water supply for their locomotive purposes at Peterborough, have at last made a valuable discovery. The boring is in a meadow at the northern end of the viaduct crossing the Nene Valley; and the supply has been found in the gravel beneath the cornbrash which enters so largely into the composition of the district. Up to the present time, the whole supply has been secured from the Peterborough Corporation wells at Braceborough, fourteen miles off, for which supply £4000 is paid annually into the borough funds. It is expected that at least half this sum will be saved; and the Corporation have written off that amount in their estimates for the coming year.

Indignation against the Rothwell Gas Company.—A curious story reaches us from the usually quiet village of Rothwell. It appears that owing to the Gas Company's stock of coal having almost run out, supplies had to be brought in from outside districts. This roused the indignation of the inhabitants; and a public meeting was held last Wednesday to protest against the conduct of the Company, who, it was said, were "cutting the throats of the very people who have paid them their high dividends." It was decided not to burn any more gas after that day; and to notify the Directors to remove the meters. A crowd of people then visited the various houses and places of business to see that the decision of the meeting in regard to discontinuing the use of gas was carried out; loud cheers being given at the places where the gas was turned off, while hooting was freely indulged in at the residences of those who kept it alight.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Waverley Association of Gas Managers, being, as is alleged, the oldest body of the kind in existence, held their 65th half-yearly meeting at Selkirk on Thursday week. The Association receives little attention—one reason for which is that their business is altogether of an informal nature, and consists, in fact, of a conversation upon current topics. There was an exception last half year, when Mr. Bell, of Peebles, laid before them the Peebles oil-gas process; but as a rule, the members do not encourage publicity in their meetings. It is just possible that in this way they get nearer each other, in speaking of matters which do not concern the general public, and may benefit more than if all they said were open to outside criticism. But on that subject there is room for two opinions. If they get from each other information which is useful, and which they would not get in a more public meeting, the members must be extremely cordial, not to say guileless. The other view is that publicity is the touchstone of thoroughness; and the Waverley Association might do well to consider whether they would not do more good, both to themselves and to their brethren outside their ranks, if they conformed to the usage of other Associations, by having more formal business and greater publicity.

The Greenock Police Board, as owners of the gas undertaking, have this week reduced the price of gas from 3s. 4d. to 3s. 2½d. per 1000 cubic feet. This, it is believed, is the outcome of the remarks made by Dr. Cluckie at the August meeting, when he compared, somewhat forcibly, the price charged by them with that which existed in Paisley. The proposal had been made in Committee that the reduction should be 2½d.; but that was not pressed at the Board meeting, against the recommendation of the Gas Committee that it should be 1½d. Even when this latter proposal was laid before the Board, there was opposition to it. The Board seem to be irretrievably given over to the objectionable practice of making as large a profit as they can, in order to make a contribution to the burgh funds. Their only notion, in discussing the subject of the reduction, was as to how it would affect this contribution. They expect, out of the gas profits of this year, to be able to hand over £2000 to the Treasurer of Police; and the question was whether they would be better able to make the contribution if they lowered the price, or if they did not make any reduction. The former opinion prevailed by 17 votes to 3. This is another step in the right direction. The next would be if they should not be able to make the contribution they propose. In that way, they would be obliged to draw again upon their sinking fund; and thus gradually they might be led into the true view, that a gas undertaking should be managed for itself and not for any extraneous object. Very strangely, the gentleman who was the greatest opponent of the reduction was the same Dr. Cluckie who, at the previous meeting, denounced the high price.

The Gourock Police Commissioners have this year estimated for a revenue of £2934, and an expenditure of £2255 from their gas undertaking, which would leave them with a gross surplus of £679; but as charges for interest, &c., amount to £600, the net surplus expected is £79. Last year there was a deficit of £51. It has been resolved to retain the price of gas at 3s. 4d. per 1000 cubic feet.

The Forfar Police Commissioners, exercised, I suppose, by the circumstance that their output of gas is declining, appear to be desirous of effecting economies in the working of their gas undertaking; and their thoughts have turned towards the number of men employed in the works. A wiseacre among them called attention this week to the fact that in Montrose more gas was manufactured with a less staff. The Commissioners therefore resolved to communicate with the authorities in the neighbouring towns, and to ask for information as to the number of men employed in the retort-house, the output of gas, the number of men employed in the yard, the hours engaged, the storeage capacity, the amount of leakage, and the wages paid.

October will be upon us in a day or two. It was only in October of last year that Mr. W. Young brought his oil-gas process into practical use at Peebles. It is difficult to realize that the process has been so short a time before the public, when one considers in how many places it is already at work or being fitted up. Besides Peebles, it is in use at Galashiels, Kelso, and Alloa; and at Musselburgh it has just been started, while in three other places it is about to be—that is, eight in all within a twelvemonth. In five other towns—two of which are in England—plant is being fitted up for the working of the system; and negotiations are in progress with the Company which now owns the patent, for the fixing of royalties and the preparation of plans, in connection with so many places that the patentees have more to do than they are able to overtake. Wherever it has been adopted, the process is giving the utmost satisfaction—it is, in fact, no longer in an experimental stage, but has leapt, in the course of a year, into established permanency. The same cannot be said of any other oil-gas process; for, if I mistake not, there is not one of them, though some have been in existence for a dozen years, of which it can be stated that they have yet got beyond the necessity of proving their case. One of the results of Mr. Young's discovery is that tar can now be used for gas making. I hear that it is being worked at three places in Scotland, and gives a yield, in gas and coke, equal to three times the price which can be got for it in the market. The correspondent who has furnished me with this information, says "there need be no more croaking about having to raise the price of gas because tar fetches a low price. Why, it is the very essence of the coal; and more than that, it has no moisture in it, but is dried and all ready up to 212° Fahr. You would notice in the JOURNAL of last week, in the report of the Hastings Gas Company, that it was stated that not long ago they carted tar to a moor and burned it. It was very common in Scotland 35 years ago to do so; and only lately Mr. George Livesey said it was more value to burn it as fuel for retorts than to sell it." These remarks bring out that Mr. Young's discovery of fractional distillation is a much greater benefit to the gas industry than was at first anticipated. If managers are able by it to work up their tar at home, they will not only secure the profit which it yields, but a great load will be taken off their minds. They will have the double lever, of the oil to keep down the price of coal and of the tar to keep up the price of residuals; and there will thus be less fluctuation from year to year in their balance-sheets.

Lord Kinnear, in the Bill Chamber of the Court of Session, at Edinburgh, had before him on Wednesday an application by Mr. W. H. Hill, engineer, of Kirkcaldy, to have Mr. W. C. Butler, Manager of the Grand Restaurant, Edinburgh, and Mr. Loxton Hunter, Managing Director of the Butler Vertical Grill Manufacturing Company, Limited, of 72, Princes Street, Edinburgh, interdicted from infringing letters patent for a vertical grill which were granted to Butler, and from issuing circulars or advertisements which would lead the public to believe that the respondents had the right to manufacture or sell the grill. Mr. Butler's invention is a gas-grill, which is so arranged that it cooks a piece of meat on both sides simultaneously. Mr. Hill claims that, by agreement entered into in December last, he acquired the sole right for seven years to manufacture and sell the grill, upon payment of certain royalties. The inventor was to be empowered to sell the patent; but the complainer was to be entitled to half the proceeds, with a right of pre-emption to him if the sum offered was less than £2000. An endeavour was made to form a company to take over the patent; but it fell through. Notwithstanding, he asserts, the respondents have issued advertisement cards relating to a company, and to a firm by whom the grills are to be made and sold, and which contain no reference to his rights as licensee. In reply, Mr. Butler says that the complainer did nothing to promote the sale of the grill, except to issue a circular; and that the complainer informed him he was unable to carry out his part of the agreement. Counsel for the respondent undertook to keep a record of all his sales; and upon this undertaking, Lord Kinnear refused to grant an interim interdict, but sent the case for trial.

The Edinburgh and District Water Trust on Thursday fixed their assessments for the current year. Their estimated expenditure is £84,764, to meet which they calculate that £35,805 will be the balance of the sum derived from meter supply and shipping, special supplies, &c., leaving £48,959 to be raised by assessment. To meet this, they imposed a domestic water-rate of 5½d. per pound, a shop rate of 2d. per pound, and a public rate of 1d. per pound, all the same as last year. In moving the adoption of these rates, Mr. Colston said that last year they expended £3053 in connection with suggested additional water supply schemes; and that this year they proposed to expend £400 upon that purpose. They were not entitled to levy more than the amount they expended, year by year; and those sums might yet be placed to capital account. Their domestic rate of 5½d. was the lowest rate levied for water in any of the larger cities of the United Kingdom. Lord Provost Russell said the rates proposed were below the average cost of the water, taken over a series of years. He did not like the swinging up and down of the taxation; and he thought it a great pity that they could not charge 6d. per pound year in and year out, and accumulate money, so that they might not have to raise the rate when they incurred capital expenditure. Mr. Colston replied that they must act as Parliament directed. Bailie Archibald said that in other large cities, if they had not the power which the Lord Provost suggested, they exercised it all the same; and in their own case, in spite of what Parliament had said, they had accumulated a cash balance of £13,000, from which they drew to a slight extent last year, and expected to draw upon to the amount of £300 this year.

A serious check has been experienced by the Edinburgh and District Water Trustees in connection with their projected scheme for the procuring of an additional water supply. The majority of the Trustees had set their heart upon the valley of the Manor—a tributary of the Tweed which joins the river above Peebles—as the source; but as the result of borings, it has been ascertained that the foundation of the embankment to form a reservoir at Posso, in the valley, would require to be carried to a great depth—on an average, somewhere about 100 feet. Doubts also arose in the minds of some as to the stability of the embankment; and in view of the responsibility of the Trust in the event of a disaster occurring, it was resolved some time ago to put specific questions upon that head to Messrs. Hill, Gale, and Mansergh, who had before been consulted, and had recommended the Manor scheme. The reply of the consulted Engineers has been received. It deals with both the Manor and the Talla schemes—the latter being another tributary of the Tweed, situated further up stream. In neither case, the Engineers say, is there any risk, so far as stability and safety are concerned. "It is for you (the Trustees) to decide, then, whether the advantage of procuring better and exceptionally beautiful water from the Manor watershed, coupled with its less cost per million gallons of the first instalment, is to outweigh the slight advantages, in other respects, of the Talla." The slight advantages of the Talla scheme are connected with the construction of the embankment. The Engineers recommend that to the £50,000 which Messrs. Leslie and Reid, the Engineers of the Trust, proposed to add to the original estimate, in respect of the extra depth of the trench at the Manor, there should be added other £10,000—making the extra cost £60,000. With this additional sum, the cost per million gallons from the Manor would be raised from £60,236 to £66,236; while the cost per million gallons from the Talla would be £77,860. Since the reply of the consulted Engineers was received, the subject has not been before any meeting; but it is rumoured that one of the Engineers does not agree with the other two, though he signed the reply. This, coupled with the fact that in the borings at Posso a great deal of water was encountered, and with the suspicion that the estimate of the Engineers would most probably be greatly exceeded, has had the effect of producing a feeling of hesitation in the minds of a number of the Trustees; and it is probable that the Manor scheme will be abandoned.

The Affairs of the London Water-Meter Company.—Last Wednesday, Mr. Justice Kennedy heard an application, on behalf of the plaintiff in an action of *Lucas v. The London Water-Meter Company, Limited*, for the appointment of a receiver and manager of the affairs of the Company, which were represented as being in a hopelessly insolvent condition. The action was on behalf of certain debenture-holders, who stated that various creditors were pressing for payment, and that it was most important that the ordinary safeguards should be procured. The Company not opposing, the order was made.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Sept.* 23.

Sulphate of Ammonia.—A violent change has come over the aspect of the market; and there has been a decided fall in prices. The reason is that the supplies, both from first and second hands, have been rather more plentiful; while simultaneously the demand, as far as actual consumers are concerned, has almost completely fallen away. This once more leaves the field to the speculators, who, while preaching *la baisse*, eagerly pick up spot parcels at the declining values. The position is, therefore, not really bad; but circumstances are against sellers at present. Quotations are down to £14 7s. 6d. Hull and Liverpool; and f.o.b. Leith even £14 2s. 6d. has been mentioned. For October delivery, there are sellers at £13 15s., and at £13 10s. for November-December. Few buyers will, however, operate at the moment. Nitrate is very quiet; but there is no change in values.

LONDON, *Sept.* 23.

Tar Products.—There was a slightly better tone for tar products during the past week. Benzols are more inquired for; but prices have not advanced. Carbolic acid is also a little better, although the prices touched have been abnormally low during the past week. Pitch is in greater request, and at a somewhat improved figure. Deliveries against contracts are also well pressed for. Anthracene has maintained the price of last week; and the position altogether is more hopeful. Prices are as follows: Tar, 12s. 6d. to 14s. Pitch, 24s. 6d. to 25s. 6d. Benzols, 50's and 90's, 1s. 5½d. Creosote salts, 16s. Creosote, 1½d. Solvent naphtha, 1s. 1½d. Toluol, 1s. 5d. Crude benzol naphtha, 30 per cent., 7d. Carbolic acid, 60's, 1s. 5d.; crystals, 6½d. Cresol, 1s. 4d. Anthracene, 30 per cent., "A," 1s. 1d.; "B," 9d.

Sulphate of Ammonia has weakened considerably since the last report; and £14 is spoken of as the price for early delivery, although there does not appear to be much changing hands at the price. Gas liquor is quoted at 8s. 6d. to 9s. 6d.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The probability of an early settlement of the dispute, as a result of negotiations which have been going on during the past week for a joint conference between representatives of the coalowners and the Miners' Federation, are at present too doubtful to have any very appreciable effect upon the demand. To some extent, with the close of last week there was a holding back of inquiries; and here and there some of the large consumers are restricting their consumption by going on short time, rather than pay present prices, in anticipation that the men may very soon be back at work. The position generally, however, remains very much the same—the supplies offering in the market being hardly sufficient to meet even the partial hand-to-mouth requirements of users. During the week there has been a further advance in the prices quoted for the small quantities of coal still held in stock in Lancashire by one or two of the coalowners; and 17s. 6d. to 20s. per ton at the pit mouth has been about the average figure. Even the largest of these stocks is scarcely likely to last much over another week. For house-fire requirements, it has not been difficult to get the top prices now quoted for round coal; but for manufacturing purposes, consumers hesitate a great deal about buying, except for very pressing requirements. Supplies have been coming in to a moderate extent from Durham and North Staffordshire, at prices ranging from 17s. to 18s. per ton for common coal, delivered at stations in the district. Not only, however, are these prices gradually hardening up, but effective measures have been taken by the Miners' Federation for putting a stop to further loading up of Lancashire waggons at the collieries in the above districts. With regard to engine fuel, prices are simply nominal, at about 14s. to 15s. per ton at the pit mouth, where collieries have anything at all to offer; but these are "fancy" figures, which are got only in exceptional cases. So far as gas coal is concerned, the outlook is rather serious for some of the companies who only hold very moderate supplies; and in some instances advances are already being made upon the prices for gas to consumers. It is certain that, even should there be not much further prolongation of the stoppage, the complete clearances of stocks will have a marked effect upon supplies during the winter; and some of the Lancashire collieries will be altogether unable to meet the ordinary demands of their customers out of the coal they can raise from their pits.

Northern Coal Trade.—There has been a slight easiness in the coal trade of the North, in contrast with the intense demand that was experienced the previous month. The recommencement of the Welsh and Staffordshire collieries has lessened the request for some classes of fuel; but though there is now more competition for the orders in the market, there is still very full work for all the collieries. Best Northumbrian steam coal is quoted at about 13s. per ton f.o.b.; but with the Welsh coal offering as low or even lower, it is to be expected that there will be a fall in the prices of Northumbrian steam coal when the most pressing orders are executed. Second qualities of coal are from 11s. 6d. to 12s. per ton; and there is a good demand for small steam coal at from 5s. to 5s. 6d. per ton—more being used for bunker coals. For manufacturing coals there has been a very strong demand from the Yorkshire and Lancashire district; and though this is rather less than it was, yet there is a considerable quantity of coal being sent for the purpose named. Gas coals are still being very largely produced; but it is on old contracts in many cases, and thus there is only a limited amount to sell at the high prices that such free coals command. The contracts that are running are generally at about 6s. per ton; whilst there have been sales of odd quantities of free coal as high as 9s. 6d. per ton f.o.b., and in one instance at least a small quantity pressingly needed was sold at 10s. per ton. It is, however, very little that is disposed of at these high prices. The collieries are working well, except Hebburn, where the miners struck against the supply of coal for the Midlands, and against whom summonses have been issued. There is not much change in the coke trade. The local demand is steady; but the shipments are rather less than they were. Best Durham coke is quoted at 15s. 6d. to 16s. per ton f.o.b., and considerable shipments have been made from the Tyne and from West Hartlepool. The demand for the local blast-furnaces is better than it was. Gas coke is in fuller supply now; but there is no alteration to report in price this week.

Scotch Coal Trade.—Things look more reasonable this week. With the threatened dispute of last week, trade showed a tendency to fall back; and prices followed. It has now been disclaimed by the masters in the West that they had any intention of reducing wages; and the men, in conference in Glasgow on Thursday, rescinded their resolution to work four, and resolved to work five days a week. This has given more freedom to the masters, who can now entertain orders; and prices have again advanced. There is a great demand, especially for small coal, for Lancashire. In the Lothians the arbitration with reference to wages is proceeding before the Board of Conciliation, with Mr. Sym, advocate, as Umpire. The men are working five days a week, with every prospect of harmony being retained. In Fife and Clackmannan, the men have resolved, on account of the improved trade, to ask for an advance to the extent of 12½ per cent. The prices quoted this week are: Main, 9s.; ell, 9s. 6d. to 10s.; splint, 9s. 6d. to 10s.; and steam, 10s. 3d. to 10s. 6d. per ton f.o.b. Glasgow. The shipments were very large, particularly at Burntisland and Methil, in Fifeshire, at which places the figures are more than double what they were the preceding week. The export over all was 211,402 tons—showing an increase of 30,834 tons, compared with the preceding week, and of 36,040 tons as compared with the corresponding week of last year. For the year to date, the total shipments have been 5,074,858 tons—a decrease of 317,065 tons upon the exports during the like period of last year.

The Case of Disputed Meter Registration.—At the West London Police Court last Thursday, the Secretary of the Brentford Gas Company (Mr. W. Croxford) gave notice of appeal against the decision of Mr. Plowden, recorded in the last JOURNAL, in the case of disputed meter registration at the house of a consumer at Hammersmith.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 577.)

Issue.	Share	When ex-Dividend	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	13 Apl.	10½	Alliance & Dublin 10 p. c.	10	17½—18½	..	5 13 6
100,000	10	,,	7½	Do. 7 p.c.	10	12—13	..	5 15 4
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	102—104	..	4 16 2
100,000	20	31 May	8	Bahia, Limited	20	10½—11½	..	13 18 3
200,000	5	12 May	6½	Bombay, Limited	5	5½—6	..	5 8 4
40,000	5	,,	6½	Do. New	4	3¾—4¼	..	5 13 0
380,000	Stck.	16 Aug.	11½	Brentford Consolidated	100	218—223	+1	5 3 1
180,000	,,	,,	8½	Do. New	100	164—169	+1	5 0 7
220,000	20	15 Sept	11½	Brighton & Hove Original	20	41—43*	+1	5 6 11
888,500	Stck.	31 Aug.	5	Bristol	100	102—105	..	4 15 3
320,000	20	13 Apl.	11½	British	20	43—45	+1	5 0 0
50,000	10	31 Aug.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
51,510	10	,,	8½	Do. 7 p. c.	10	15—16	..	5 6 3
328,750	10	28 July	2	Buenos Ayres (New) Limited	10	5½—6½	..	3 1 6
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	97—100	..	6 0 0
150,000	20	13 July	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	28 Apl.	12½	Commercial, Old Stock	100	247—252	+4	4 19 2
165,000	,,	,,	9½	Do. New do.	100	187—192	+2	4 18 11
160,762	,,	15 June	4½	Do. 4½ p. c. Deb. do.	100	125—130	..	3 9 3
800,000	Stck.	15 June	13	Continental Union, Limited	100	230—235	..	5 10 7
200,000	,,	,,	10	Do. 7 p. c. Pref	100	191—196	..	5 2 0
75,000	Stck.	15 Sept.	10	Crystal Palace District	100	185—190*	..	5 5 3
486,090	10	28 July	10	European, Limited	10	21—22	..	4 10 11
354,060	10	,,	10	Do. Partly paid	7½	15—16	..	4 13 9
5,646,590	Stck.	16 Aug.	12	Gaslight & Coke, A, Ordinary	100	231—235	+3½	5 2 1
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	95—100	..	4 0 0
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	262—267	+1	3 14 10
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	120—125	..	4 0 0
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	175—180	..	4 3 4
1,300,000	,,	,,	7	Do. H, 7 p. c. max	100	170—175	+2	4 0 0
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	260—265	..	3 15 6
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	155—160	..	3 15 0
1,061,150	,,	15 June	4	Do. 4 p. c. Deb. Stk.	100	126—129	..	3 2 0
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	128—132	..	3 8 2
908,000	,,	,,	6	Do. 6 p. c. do	100	172—177	..	3 7 9
3,800,000	Stck.	12 May	12	Imperial Continental	100	228—233	+2	5 3 0
75,000	5	15 June	6	Malta & Mediterranean, Ltd.	5	5½—5¾	..	5 4 4
560,000	100	4 Apl.	5	Met. of Melbourne, 5p. c. Deb.	100	104—106	..	4 14 4
541,920	20	15 June	5	Monte Video, Limited	20	12¾—13½	..	7 8 2
150,000	5	31 May	10	Oriental, Limited	5	7½—8	..	6 5 0
60,000	5	29 Mar.	7	Ottoman, Limited	5	4—4½	..	7 15 6
166,870	10	—	2	Pará Limited	10	2—2½	..	—
420,000	100	2 May	6	People's Gas of Chicago—1st Mtg. Bds.	100	100—105	..	5 14 3
500,000	100	1 June	6	2nd Do.	100	98—102	..	5 17 8
150,000	10	28 Apl.	5	San Paulo, Limited	10	8—9	..	5 11 1
500,000	Stck.	31 Aug.	15½	South Metropolitan, A Stock	100	304—309	+9	5 0 4
1,350,000	,,	,,	12	Do. B do.	100	248—253	+4	4 14 10
260,000	,,	,,	13	Do. C do.	100	257—262	+7	4 19 2
750,000	,,	13 July	5	Do. 5 p. c. Deb. Stk.	100	148—152	..	3 5 9
60,000	Stck.	31 Aug.	11½	Tottenham & Edm'nton, "A"	100	210—215	..	5 7 0
				WATER COMPANIES.				
744,897	Stck.	29 June	10	Chelsea, Ordinary	100	266—271	+1	3 13 10
1,720,252	Stck.	29 Mar.	8	East London, Ordinary	100	218—222	+3½	3 12 1
544,440	,,	29 June	4½	Do. 4½ p. c. Deb. Stk.	100	140—143	..	3 2 11
700,000	50	15 June	8½	Grand Junction	50	111—115	+2½	3 13 11
708,000	Stck.	16 Aug.	11	Kent	100	285—290	+8	3 15 10
1,043,800	100	29 June	9½	Lambeth, 10 p. c. max.	100	243—248	+2	3 16 7
406,200	100	,,	7½	Do. 7½ p. c. max.	100	199—204	+2	3 13 6
310,000	Stck.	29 Mar.	4	Do. 4 p. c. Deb. Stk.	100	129—132	..	3 0 7
500,000	100	16 Aug.	12½	New River, New Shares	100	333—338	+6	3 11 9
1,000,000	Stck.	28 July	4	Do. 4 p. c. Deb. Stk	100	132—135	..	2 19 3
902,300	Stck.	15 June	6	S'thwk & V'xhall, 10 p. c. max.	100	153—158	+3	3 15 11
126,500	100	,,	6	Do. D 7½ p. c. do.	100	142—147	+2	4 1 7
1,155,066	Stck.	15 June	10	West Middlesex	100	263—268	+3	3 14 7

*Ex Div

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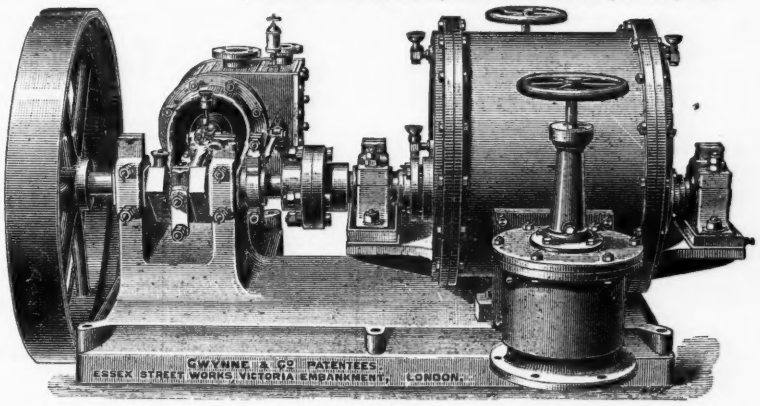

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Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

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Telegrams: "HUTCHINSON BROS., BARNSLEY."

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ALFRED WEST,
Manager and Secretary.

Gas Offices, Rastrick,
Sept. 16, 1893.

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The Gaslight and Coke Company,
Chief Office: Horseferry Road,
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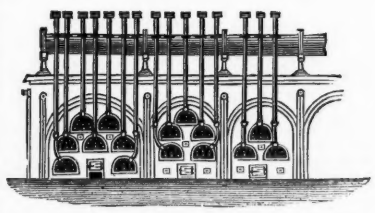

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Hydrogen	5·116
Oxygen	7·401
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Sulphur	0·620
Ash	3·130
Water	0·020
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Analysis of the Coke.

Carbon	93·31
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Ash	5·00
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Yours truly,
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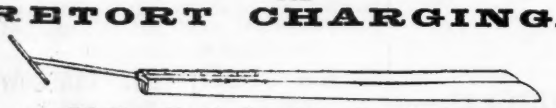
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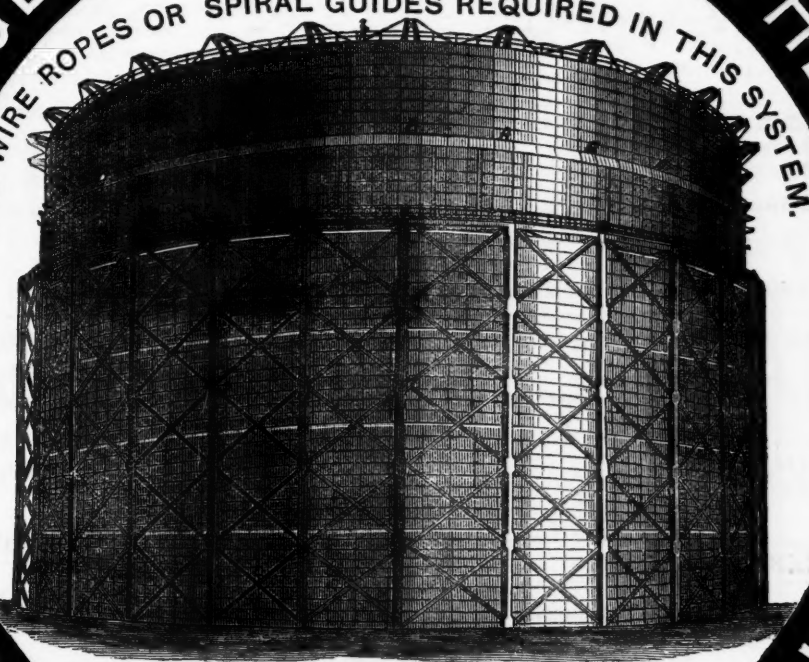

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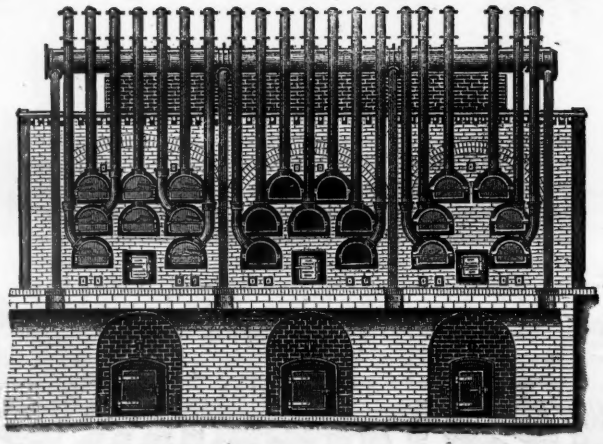

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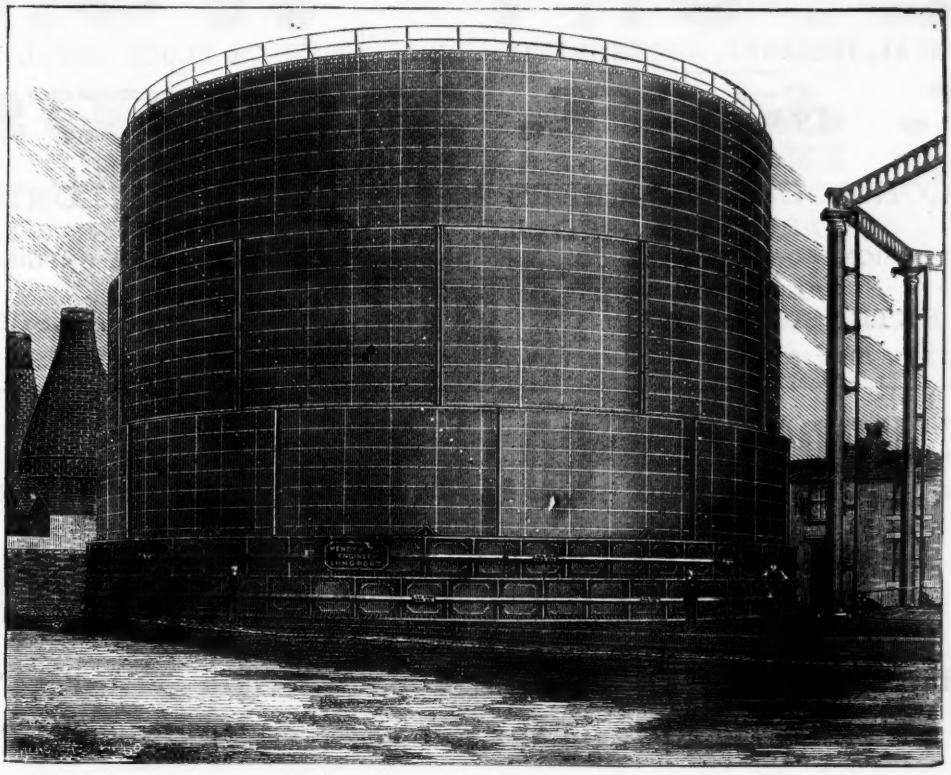

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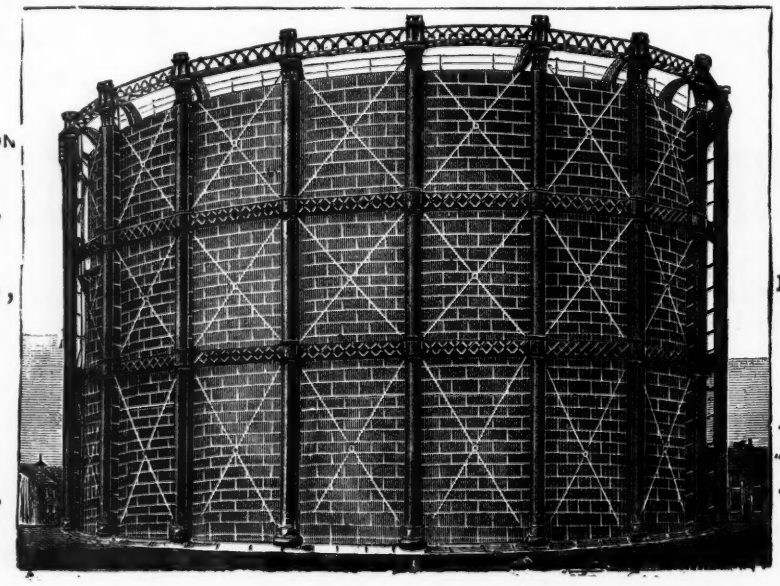

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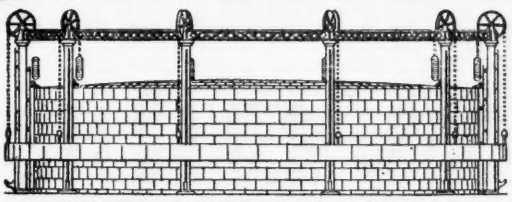

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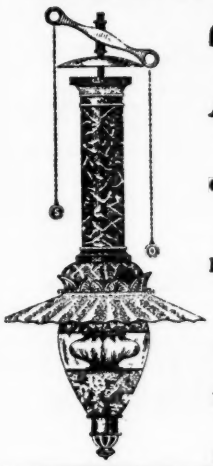

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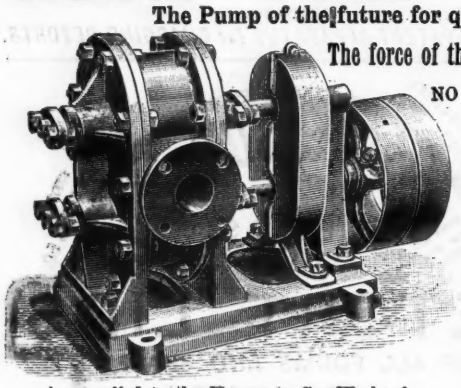

As supplied to the Harrogate Gas-Works for Pumping Gas Liquor.

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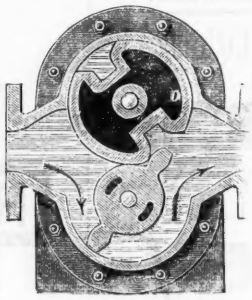

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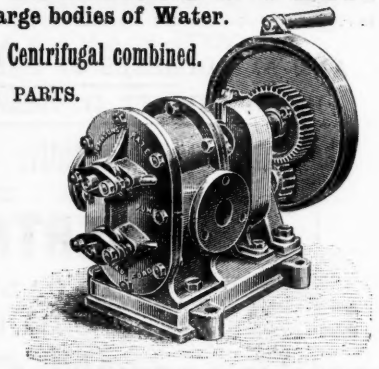

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